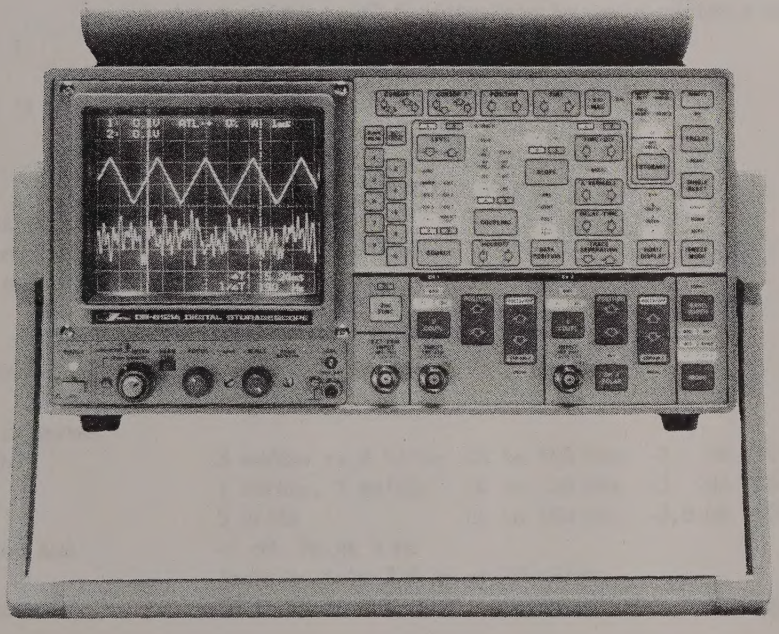
DIGITAL STORAGESCOPE

# DS-6121/DS-6121A

## OPERATORS MANUAL



IWATSU ELECTRIC CO., LTD.

# Section 1 Specifications

## 1-1 GENERAL

The DS-6121 is an easy-to-use, high-grade oscilloscope with digital storage mode and equivalent sampling function, suitable for multiple purposes and a with range of applications.

The DS-6121 may also be used as a programable oscilloscope using a personal computer as a controller via the GP-IB (or RS-232-C) interface for research and development purposes, and also can increase the efficiency of production and inspection lines.

## 1-2 ELECTRICAL SPECIFICATIONS

### 1-2-1 Vertical Deflection System (Channels 1 and 2)

| | |
|---|---|
| Deflection factor | |
| Range | 1 mV/div to 5 V/div in a 1-2-5 sequence of 12 steps |
| | 1 mV/div to 12.5 V/div, continuously variable with the VARIABLE |
| Accuracy I | 2% at 5 mV to 5 V (10°C to 35°C) |
| | 4% at 1 mV and 2 mV (10°C to 35°C) |
| Accuracy II | 5% at 5 mV to 5 V ( 0°C to 40°C) |
| | 8% at 1 mV and 2 mV ( 0°C to 40°C) |
| Input RC | Direct: 1 MΩ± 1.5%//25 pF ±2 pF |
| | With probe: 10 MΩ±2%//14 pF ± 2 pF |
| Maximum input voltage | ±250 V MAX |
| Input coupling | AC, DC, GND |
| Common mode rejection ratio | 50:1 (1 kHz sine wave) |
| Inversion | CH 2 only |

#### 1-2-1-1 Nonstorage (Real)

| | | | |
|---|---|---|---|
| Frequency response | | | |
| Bandwidth | 5 mV/div to 2 V/div | DC to 100 MHz | -3 dB (10°C to 35°C) |
| | 1 mV/div, 2 mV/div | DC to 50 MHz | -3 dB (10°C to 35°C) |
| | 5 V/div | DC to 100 MHz | -3.5 dB (10°C to 35°C) |
| AC coupled low | -3 dB Point 4 Hz | | |
| Rise time | Approximately 3.5 ns at 10 mV/div | | |
| Vertical mode | CH 1, CH 2, ALT, CHOP (switching rate: approximately 500 kHz), ADD | | |

#### 1-2-1-2 Storage

| | |
|---|---|
| Frequency response | |
| One shot | |
| Curve interpolation OFF | DC to 10 MHz (1-channel operation) |
| | DC to 5 MHz (2-channel operation) |
| Equivalent sampling | DC to 100 MHz |
| Vertical mode | CH 1, CH 2, CH 1 & CH 2, CH 1 CH 2 & REF |

## 1-2-2 Triggering

A TRIGGER

Sensitivity

Maximum trigger level (10°C to 35°C)

| Frequency Range | Level | |
|---|---|---|
| | CH 1, CH 2 | EXT |
| DC to 10 MHz | 0.4 div | 0.1 V |
| Up to 50 MHz | 1.0 div | 0.1 V |
| Up to 100 MHz | 1.5 div | 0.1 V |

<Note>

- Trigger signals are attenuated in the following frequency ranges depending on coupling
  AC 100 Hz or lower
  HF REJ 10 kHz or higher
  LF REJ 10 kHz or lower
- Auto sweep mode: The lower usable frequency is 50 Hz
- TV-V, TV-H synchronizing signal level: 1 div or more on screen amplitude for a composite video signal composed of 7 parts video signal and 3 parts synchronizing signal

Source: CH 1, CH 2, EXT, NORM, LINE
AC, DC, HF REJ, LF REJ, TV-V

Slope: +, -

External trigger input

Maximum input voltage: ±250 V MAX

Input RC: 1 MΩ ± 3%//25 pF ± 5% (Both A and B COUPLINGs are DC)
1.2 MΩ ± 3%//25 pF ± 5% (Either A or B COUPLING is DC)
1.5 MΩ ± 3%//25 pF ± 5% (Neither A nor B COUPLING is DC)

B TRIGGER

Minimum trigger level: Same as in A TRIGGER Table

Source: RUN AFTER DELAY, CH 1, CH 2, EXT

Coupling: AC, DC, HF REJ, TV-H

Slope: +, -

External trigger input: Same as A TRIGGER

## 1-2-3 Horizontal Deflection System

| | |
|---|---|
| Sweep mode | AUTO, NORM, SINGLE |
| Sweep magnification | 10 times |
| Accuracy I | 20 nsec/div and 50 nsec/div 6% (10°C to 35°C) |
| (Over center 8 divisions) | 0.1 µsec/div to 0.5 sec/div 3% (10°C to 35°C) |
| Accuracy II | 20 nsec/div and 50 nsec/div 7% ( 0°C to 40°C) |
| (Over center 8 divisions) | 0.1 µsec/div to 0.5 sec/div 5% ( 0°C to 40°C) |
| Holdoff time | Continuously variable |

### 1-2-3-1 Nonstorage (Real)

| | |
|---|---|
| HORIZ DISPLAY | A, A INTEN, A INTEN & B (DLY'D), B (DLY'D), X-Y |
| A SWEEP | |
| Sweep time | 20 ns/div to 0.1 s/div in a 1-2-5 sequence of 21 steps |
| Accuracy I | 2% (10°C to 35°C) |
| (Over center 8 divisions) | |
| Accuracy II | 4% ( 0°C to 40°C) |
| (Over center 8 divisions) | |
| Roll mode | 0.2 s/div to 10 s/div |
| B SWEEP | |
| Delay | |
| Continuous delay | CH 1, CH 2, EXT |
| Triggered delay | RUN AFTER DELAY |
| Sweep time | 20 ns/div to 0.1 s/div in a 1-2-5 sequence of 21 steps |
| Accuracy I | 2% (0°C to 40°C) |
| (Over center 8 divisions) | |
| Accuracy II | 4% (0°C to 40°C) |
| (Over center 8 divisions) | |
| Delay jitter | 1/10,000 or less |

### 1-2-3-2 Storage

| | |
|---|---|
| HORIZ DISPLAY | A, A INTEN, B (DLY'D), X-Y |
| A Sweep Time | |
| Single shot | 20 ns/div to 10 s/div and EXT |
| Equivalent sampling | |
| 1 channel | 20 ns/div to 2 s/div |
| 2 channels | 20 ns/div to 5 s/div |
| B Sweep Time | Same as Nonstorage |

## 1-2-4 X-Y Operation

### 1-2-4-1 Nonstorage (Real)

| | |
|---|---|
| X AXIS | |
| Input connector | CH 1 |
| Deflection factor | Sams as that of CH 1 |
| Bandwidth | DC to 2 MHz |
| Y AXIS | |
| Input connector | CH 2 |
| Deflection factor | Same as that of CH 2 |
| Bandwidth | Same as that of CH 2 |
| X-Y Phase Defference | 3° or less (DC to 100 kHz) |

### 1-2-4-2 Storage

| | |
|---|---|
| X axis | CH 1 or REF 1 |
| Y axis | CH 2 or REF 2 |

## 1-2-5 Z-axis

| | |
|---|---|
| Sensitivity | 0.5 Vp-p or more |
| Slope | Positive-going signal decreases intensity |
| Bandwidth | DC to 5 MHz |
| Input resistance | 10 kΩ ± 20% |
| Maximum input voltage | ±50 V MAX |

## 1-2-6 CRT Read Out and Cursor Measurement

| | |
|---|---|
| CRT read out | The following parameters are displayed<br>CH 1 deflection factor, CH 2 deflector factor<br>A trigger level, B trigger level<br>A SWEEP time, B SWEEP time, DELAY TIME MULTI, HOLDOFF time (%)<br>REF 1 deflection factor, REF 2 deflection factor<br>Various modes (Intplting, Equ-sampling, etc.) |
| Cursor measurement | Voltage measurement<br>Voltage ratio (displayed in dB and %)<br>Time measurement<br>Phase measurement<br>Voltage on waveform measurement |

## 1-2-7 CRT Display

| | |
|---|---|
| Shape | Rectangular, 6 inches |
| Display area | 8 div × 10 div (1 div = 10 mm) |
| Phosphor | B31 |
| Accelerating voltage | Approximately 20 kV |

## 1-2-8 Set Up Function

| | |
|---|---|
| No. of memories | 4 |
| Kinds | Set up in the state of power OFF<br>Set up in the state of final waveform capture before power OFF (Valid for STORAGE only)<br>Default |

## 1-2-9 Digital Storage

| | |
|---|---|
| A/D converter | |
| Resolution | 8 bits, 25 levels/div |
| Maximum clock rate | 1 channel operation: 40 MHz<br>2 channel operation: 20 MHz |
| Memories | |
| Capture memory | 2048 words × 2 channels |
| Display memory | 512 words × 4 traces |
| No. of waveforms that can be saved | 4 |
| No. of averagings | 2, 4, 8, 16, 32, 64, 128, 256 |
| Interpolation function | Curve interpolation<br>Step interpolation<br>Vector interpolation for displayed waveform |
| Calculation functions | CH 1 + CH 2<br>CH 1 - CH 2<br>CH 1 × CH 2 |
| GO/NO GO judgement | |
| Area setting | 4 cursors<br>2 waveforms and 2 cursors<br>In addition, IN and OUT ranges can be selected; FREEZE IF NO GO or CONTINUE can be selected. |
| Waveform output | |
| X-Y recorder | Automatically draws scales |
| Plotter | GP-IB or RS-232-C interface pack Iwatsu SR-6620, SR-6602 or SR-6625 necessary |
| Waveform enlarging | |
| Vertical | × 1/10 to × 10 |
| Horizontal | × 1 to × 100 |
| Data positions | FULL POST (Delay 0)<br>POST (Delay -1/8)<br>CENTER (Delay -1/2)<br>PRE (Delay -7/8) |

## 1-2-10 Single Output

| | |
|---|---|
| Calibrators | |
| Output voltage | 0.6 V |
| Accuracy I | 1% (10°C to 35°C) |
| Accuracy II | 1.5% ( 0°C to 40°C) |
| Waveform | Square wave |
| Repetition frequency | 1 kHz |
| Accuracy I | 1% (10°C to 35°C) |
| Accuracy II | 1.5% ( 0°C to 40°C) |
| Output current | 10 mA |
| Accuracy I | 1.5% (10°C to 35°C) |
| Accuracy II | 2% ( 0°C to 40°C) |

### 1-2-10-1 Nonstorage (Real)

| | |
|---|---|
| CH 1 signal output | |
| Output voltage | 30 mV ±20% per division of displayed signal (with 50 Ω load) |
| Frequency response | DC to 50 MHz -3 dB |
| Output resistance | 50Ω ±20% |
| A gate output | |
| Output voltage | Approximately ±5 V (reference voltage: About 0 V) |
| Output resistanceq | Approximately 2.7 kΩ |
| B gate output | Same as A gate output |

### 1-2-10-2 Storage

| | |
|---|---|
| PEN Y signal output | |
| Output voltage | Approximately 0.2 V per division of displayed signal |
| Output resistance | 1.1 kΩ ±20% |
| PEN X signal output | Same as Y signal output |
| PEN UP/DOWN output | |
| Output voltage | Approximately +5 V (reference voltage: About 0 V) |
| Output resistance | 500Ω ±20% at 0 V<br>2.9 kΩ ±20% at 0 V |
| GO/NO GO judgement output | |
| Output voltage | Approximately +5 V (reference voltage: About 0 V) |
| Output resistance | 1 kΩ ±20% at 0 V<br>3.3 kΩ ±20% at +5 V |

## 1-2-11 Battery Back Up

| | |
|---|---|
| Back up item | ALL SET UP and 4 Waveform Memories |
| Back up time | 10 days (-20°C to +70°C) |

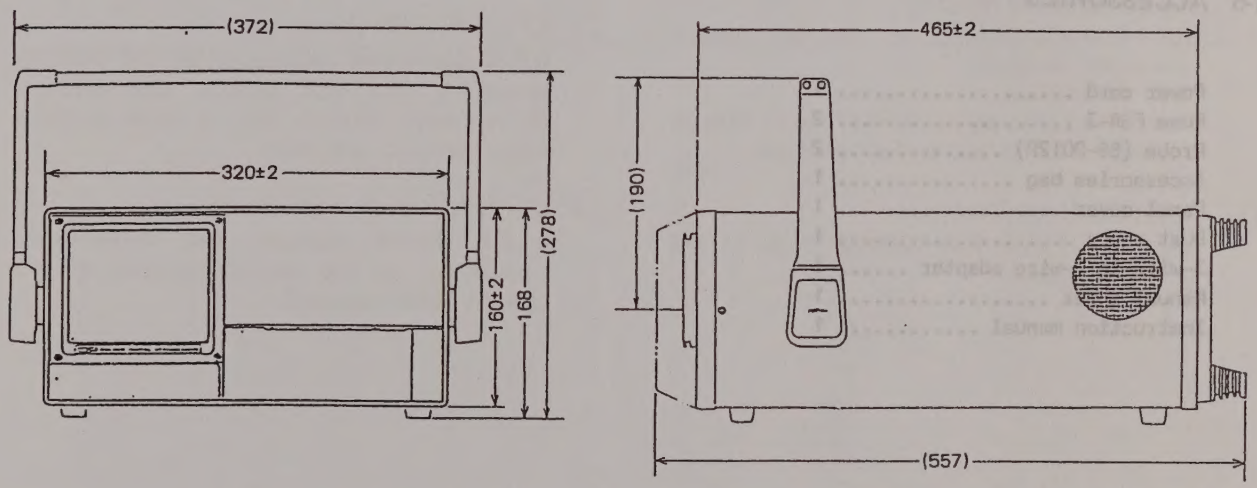
### 1-2-12 Power Supply

| | |
|---|---|
| Voltage range | 100 (90 to 110)/115 (103 to 128)/220 (195 to 242)/230, 240 (207 to 250) VAC<br>One of these voltage ranges can be selected with voltage select plug |
| Bandwidth | 50 to 440 Hz |
| Power consumption | Approximately 160 VA (at 100 V) |

## 1-3 DIMENSIONS AND WEIGHT

| | |
|---|---|
| Weight | Approximately 14 kg |
| Dimensions | 320±2 (W) × 160±2 (H) × 465±2 (L) [mm] |

Figure 1-3. Dimensions



## 1-4 ENVIRONMENTAL CHARACTERISTICS

| | |
|---|---|
| Operating temperature | 0°C to 40°C |
| Operating humidity | 40°C, 90% relative humidity |
| Storage temperature | -20°C to +70°C |
| Storage humidity | 70°C, 80% relative humidity |
| Altitude | Operating: 5,000 m maximum (atmospheric pressure 405 mmHg)<br>Non-operating: 15,000 m maximum (atmospheric pressure 90 mmHg) |
| Vibration | From 10 Hz to 55 Hz and back in 1 minute; double amplitude 0.63mm; for 15 minutes each in vertical, horizontal, and longitudinal directions for a total of 45 minutes. |
| Impact | One side is raised to an elevation angle of 30° (10 cm maximum), and let fall on a piece of hard wood. Each side is put to this test 3 times. |
| Drop | A package ready for transportation is dropped from a height of 60 cm. |

## 1-5 ACCESSORIES

| | |
|---|---|
| Power cord | 1 |
| Fuse FSA-3 | 2 |
| Probe (SS-0012R) | 2 |
| Accessories bag | 1 |
| Panel cover | 1 |
| Dust cover | 1 |
| 3-wire to 2-wire adapter | 1 |
| Manual sheet | 1 |
| Instruction manual | 1 |

### 2-1-1 Power and Display

① POWER

A push-push switch used to turn the instrument power on and off. It must be pushed in to apply power to the instrument and pushed in again to release the switch and remove power from the instrument.

② Power On Indicator

Illuminates when POWER switch is set to the "on" position and power is applied to the instrument.

③ INTENSITY (Slate Grey)

Adjusts brightness of the CRT trace display. This control does not affect intensity of the CRT readout display.

④ CHARACTER INTENSITY (Slate Grey) and PUSH ENHANCE (Warm-grey)

**CHARACTER INTENSITY:**
Adjusts the intensity of the CRT readout (character) display.
**PUSH ENHANCE:**
Enhances brightness of the CRT trace display when this knob is set to "on" position.

⑤ PUSH ENHANCE Indicator

Illuminates when PUSH ENHANCE knob is set to "on" position.

⑥ BEAM FIND

When held in, the display is compressed to within the graticule area and a visible viewing intensity is provided to aid in locating off-screen displays.

⑦ FOCUS

Adjusts for optimum display definition.

⑧ ASTIG

Screwdriver control used in conjuntion with the FOCUS control to obtain a well-defined display. It does not require readjustment during normal use of the instrument.

⑨ SCALE

Adjusts graticule illumination.

⑩ TRACE ROTATION

Screwdriver control used to align a baseline trace with the horizontal graticule lines.

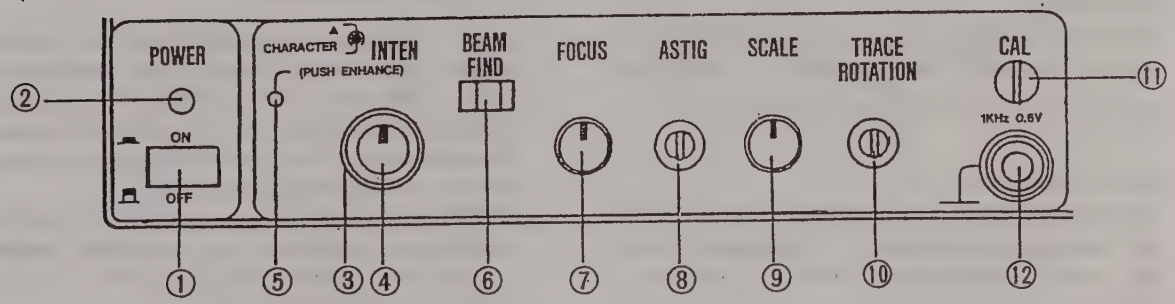
⑪ CALIBRATOR Output

0.6 V square-wave voltage output (at approximately 1 kHz) that permits the operator to compensate voltage and to check oscilloscope vertical operation.

⑫ ⊥ (Ground terminal)

Signal ground terminal for measurement. Connect it to the ground terminal of the circuit to be measured.

Figure 2-1-1. Power, Supply and Calibrator



## 2-1-2 Vertical Deflection System

### ⑬ VOLTS/DIV

Selects the vertical deflection factor from 1 mV/DIV to 5 V/DIV in 12 steps for CH 1 and CH 2 in a 1-2-5 sequence.

### ⑭ VARIABLE

Provides variable uncalibrated deflection factors between the calibrated settings of the VOLTS/DIV when [2nd FUNC] is set to ON.

### ⑮ UNCAL Indicator

Illuminates when the VARIABLE is out of the calibrated position. It indicates that the vertical deflection factor is uncalibrated.

### ⑯ POSITION

Controls the vertical position of the channel displays. In the X-Y mode, the CH 2 POSITION control adjusts the vertical positioning of the display.

### ⑰ V COUPL

Selects the method of coupling the input signal to the vertical deflection system.

**AC:** Signals are capacitively coupled to the vertical deflection system. The DC component of the input signal is blocked.

**DC:** All frequency components of the input signal are passed to the vertical input amplifier.

**GND:** The input of the vertical amplifier is grounded to provide a ground reference and to allow the input coupling capacitor to be precharged to the input signal DC level through a high resistance connected to ground.

### ⑱ CH 1 (or X) and CH 2 (or Y) Connectors

Provide for application of external signals to the inputs of the vertical deflection system or for an X-Y display. In the X-Y mode, the signal connected to the CH 1 (or X) connector provides horizontal deflection, and the signal connected to the CH 2 (or Y) connector provides vertical deflection.

### ⑲ Vertical MODE

Selects the vertical mode of operation.

- **WHEN STORAGE OFF (REAL): SELECT CH 1, CH 2, ALT, CHOP, ADD**
- **WHEN STORAGE ON: SELECT CH 1, CH 2, CH 1 & CH 2, CH 1 CH 2 & REF**

**CH 1:** Selects CH 1 input signal for display.
**CH 2:** Selects CH 2 input signal for display.
**ALT:** When ALT is selected, the Vertical Switching circuitry is alternately switched between two of the selected vertical modes at the end of each sweep.
**CHOP:** When CHOP is selected, the Vertical Switching circuitry is switched between two of the selected vertical modes at approximately a 500-kHz rate.
**ADD:** Selects the algebraic sum of CH 1 and CH 2 input signals to be displayed.
**CH 1 & CH 2:** Displays two digitized signals simultaneously that are applied to CH 1 and CH 2.
**CH 1 CH 2 & REF:** Signals to be applied to the CH 1 and CH 2 can be saved in memory 1) to 4) and display two of them in the REF 1 and the REF 2. Transfers the CH 1 and CH 2 to the REF 1 and REF 2 by MOVE function.

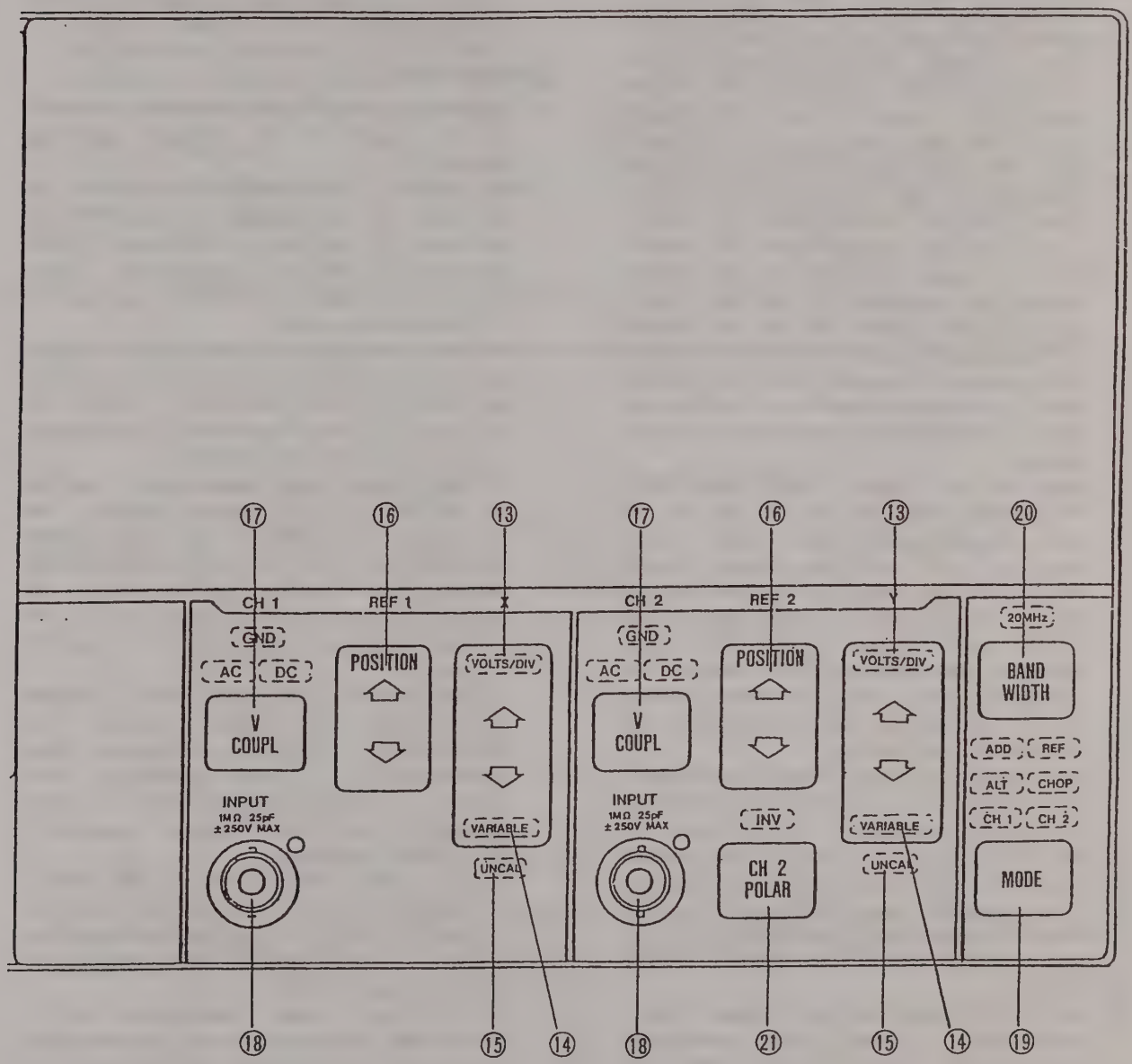
### ⑳ 20 MHz BANDWIDTH

Limits the bandwidth of the vertical amplifier to approximately 20 MHz. A LED illuminates to indicate that the bandwidth is limited to 20 MHz.

### ㉑ CH 2 POLAR

Inverts CH 2 display. A LED illuminates to indicate that the polarity is inverted.

Figure 2-1-2. Vertical Deflection System



## 2-1-3 TRIGGERING

### ㉒ SOURCE

Selects the source of the trigger signal coupled to the input of the trigger circuit.

**CH 1:** The signal applied to the CH 1 input connector is the source of the trigger signal. CH 2 signal display is unstable if it is not time related to the CH 1 signal.

**CH 2:** The signal applied to the CH 2 input connector is the source of the trigger signal. The CH 1 signal display is unstable if it is not time related to the CH 2 signal.

**EXT:** The signal connected to the External Trigger Input connector is used for triggering. External signals must be time related to the displayed signal for stable display. This position is useful when the internal signal is either too small or contains undesired components that cause unstable triggering.

**NORM (in the A Sweep Trigger circuit only):** The waveform displayed on the CRT is the source of a composite trigger signal. Stable triggering of non-time-related signals usually can be obtained by setting VERT MODE to ALT, SOURCE to NORM, COUPLING to LF REJ (high-frequency signals only), and adjusting the Trigger LEVEL control for a stable display. Time relationship between the CH 1 signal and the CH 2 signal is not indicated by the display.

**LINE (in the A Sweep Trigger circuit only):** The ac-power source waveform is the source of the trigger signal. This position is useful when the input signal is time related (multiple or submultiple) to the frequency of the ac-power source or when it is desirable to provide a stable display of a power-source frequency component in a complex waveform.

**RUN AFTER DELAY (in the B Sweep Trigger circuit only):** B Sweep starts immediately after the delay time selected by the DELAY TIME POSITION control. In this position, the B Sweep is independent of the B trigger signal.

### ㉓ EXT TRIG INPUT

Provides for application of external triggering signals to the A TRIGGER and B (DLY'D) TRIGGER circuits, when either EXT SOURCE is selected.

### ㉔ COUPLING

Determines method used to couple a signal to the input of the trigger generator circuit.

**AC:** Signals are capacitively coupled to the input of the trigger circuit. The dc component is rejected, and signals below approximately 100 Hz are attenuated. Triggering is allowed only on the ac portion of the vertical signal.

**DC:** All frequency components of a trigger signal are coupled to the input of the trigger circuit. This position is useful for providing a stable display of low-frequency or low-repetition-rate signals.

**HF REJ:** Signals are capacitively coupled to the input of the trigger circuit. The dc component is rejected, and signals below approximately 10 Hz and above approximately 500 kHz are attenuated. This position is useful for providing a stable display of the low-frequency components of a complex waveform.

**LF REJ:** Signals are capacitively coupled to the input of the trigger circuits. The dc component is rejected, and signals below approximately 10 kHz are attenuated. This position is useful for providing a stable display of the high-frequency components of a complex waveform.

**TV-V (in the A Sweep Trigger circuit only):** This trigger coupling is used for observing a composite video signal waveform over a period of 1 V by triggering with a television vertical trigger pulse.

**TV-H (in the B Sweep Trigger circuit only):** This trigger coupling is used for observing a composite video signal waveform over a period of 1 H by triggering with a television horizontal trigger pulse.

### ㉕ SLOPE

Selects the slope of the signal that triggers the sweep.

**+ (plus):** Sweep can be triggered from the positive-going portion of a trigger signal.

**— (minus):** Sweep can be triggered from the negative-going portion of a trigger signal.

### ㉖ A TRIG'D Indicator

Illuminates to indicate the A Sweep is triggered.

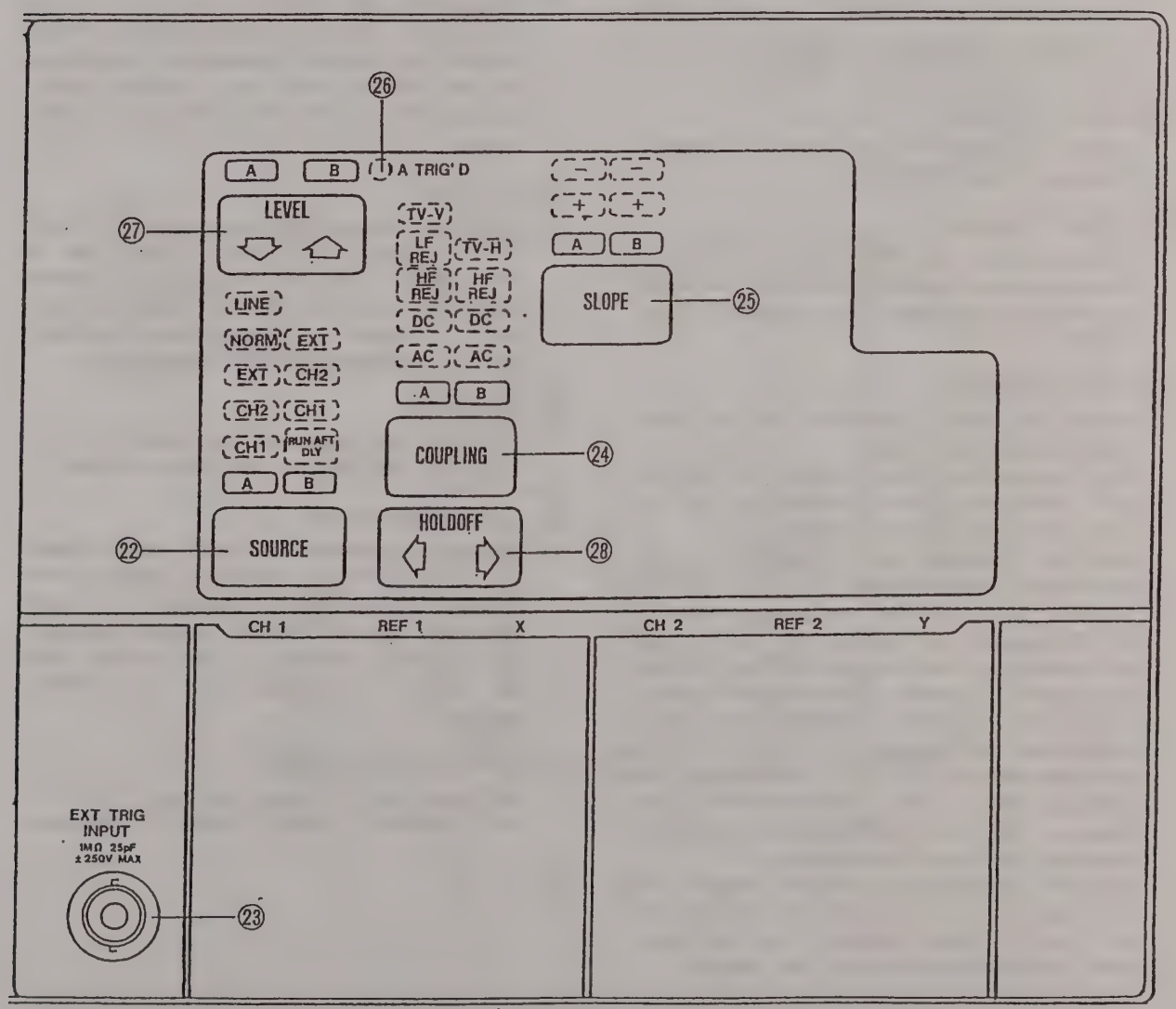
### ㉗ LEVEL

Selects the amplitude point on the trigger signal at which the sweep is triggered. This control is usually adjusted for the desired display after the Trigger SOURCE, COUPLING, and SLOPE have been selected.

### ㉘ HOLDOFF

Provides continuous control of holdoff time between sweeps. Allows triggering on a periodic signals (such as complex digital words).

Figure 2-1-3. TRIGGERING



## 2-1-4 Horizontal System

### (29) SWEEP MODE

Determines the mode of trigger operation for the instrument.

**AUTO:** Permits triggering on waveforms with a repetition rate of about 20 Hz or greater. Sweep free runs and provides a bright baseline when either an adequate trigger signal is absent, or if the repetition rate of the trigger signal is below 20 Hz.

**NORM:** Sweep is initiated when an adequate trigger signal is applied.

**SI** Sweep is initiated one time when an adequate trigger is applied. Sweep cannot be initiated again until the sweep logic is reset by pressing the SINGLE RESET

### (30) SINGLE RESET

Sweep is initiated one time by pressing this key in the SINGLE mode.

### (31) READY Indicator

Illuminates in the SINGLE mode to indicate that the sweep circuitry is armed and ready to initiate the sweep when a trigger signal occurs.

### (32) HORIZ DISPLAY

Select the mode of operation for the horizontal deflection system.

**A:** Displays only the A Sweep. The horizontal deflection rate are determined by the setting of the A TIME/DIV switch.

**A INTEN:** Displays the A Sweep at a rate determined by the setting of the A TIME/DIV switch. An intensified portion corresponding to the length and position of the B Sweep will appear on the trace when the B Sweep is properly triggered. The INTENSITY control should be adjusted to obtain the proper brightness for viewing.

**A INTEN and B DLY'D (ALT):** Alternates the display between the A INTEN and B DLY'D sweeps. The TRACE SEPARATION control will position the B display vertically.

**B DLY'D:** Displays only the B Sweep. The B Sweep rate is determined by the setting of the B TIME/DIV switch, and the delay time is determined by DEALY TIME control.

### (33) A and B TIME/DIV

**A TIME/DIV:** Selects 27 calibrated sweep rates from 10 s to 20 ns/DIV in a 1-2-5 sequence.

**B TIME/DIV:** Selects 21 calibrated sweep rates from 0.1 s to 20 ns/DIV in a 1-2-5 sequence.

### (34) A VARIABLE

Provides continuously variable uncalibrated A Sweep rates to at least 2.5 times the calibrated setting. This control is effective only in the STORAGE OFF (REAL).

### (35) UNCAL Indicator

Illuminates to indicate that the A time base sweep rate is uncalibrated (VARIABLE control is out of calibrated position). In the STORAGE modes the VARIABLE control is ignored, and the UNCAL LED is not illuminated.

### (36) X10 MAG

Increases the displayed sweep rate by factor of 10. Extends the fastest sweep rate to 20 ns/DIV. The magnified sweep expands the center division of the unmagnified display. Indicator LED illuminates to indicate that the horizontal display is magnified.

### (37) POSITION

Positions the displays horizontally. Provides both coarse and fine control action.

### (38) DELAY TIME

Selects the amount of delay time between the start of the A Sweep and start of the B Sweep. Delay time is variable to at least 10 times the A TIME/DIV switch setting. This control is used in conjunction with the RUN AFT D'LY position of the B SOURCE switch.

### (39) TRACE SEPARATION

Positions the B Sweep vertically when the ALT horizontal display mode is selected.

## ㊵ DATA POSITION

Selects the amount of pre-trigger data displayed when in STORAGE ON.

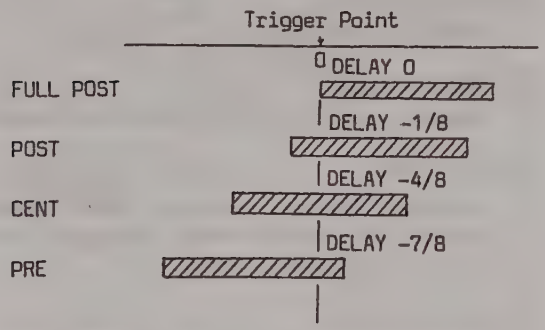
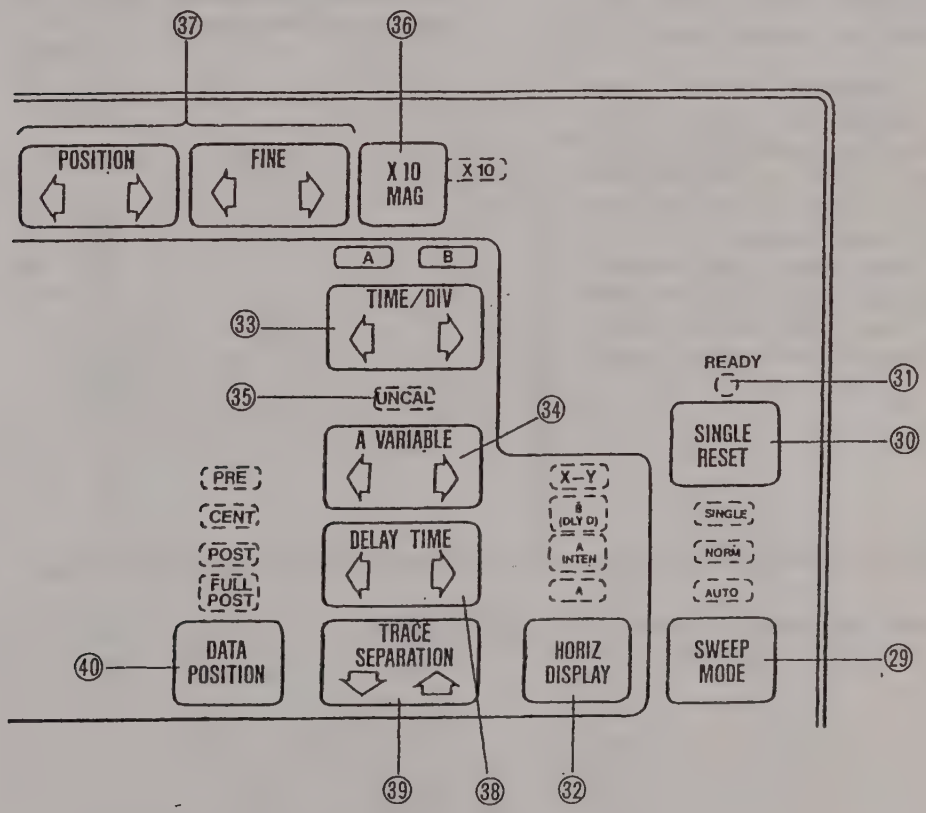



Figure 2-1-4. Horizontal System



## 2-1-5 STORAGE, GUIDE MENU and Others

### ㊶ STORAGE

Selects STORAGE ON (storage-scope) or OFF (oscilloscope).

### ㊷ FREEZE

Selects whether freeze storage waveform or not in storage ON mode.

### ㊸ REMOTE

Illuminates when REN (REMOTE ENABLE) line of GP-IB is controlled in TRUE state.

### ㊹ WRITE STATUS Indicator

**WRITE BUSY:** Illuminates during WRITE operation, and goes off when WRITE operation is completed.

**TRIG READY:** Illuminates in a state ready to receive a trigger signal. Goes off, therefore, after the trigger signal was received.

**TRIG INHIBIT:** Illuminates in a state not ready to receive a trigger signal. TRIG READY state is reached after a set WORD number of CLOCKS are passed while POST, CENT, or PRE was selected for DATA POSITION. The trigger signal is not received if TRIG READY state is not reached.

**TRIG'D:** Illuminates when a trigger pulse is generated. Check that this is illuminating when writing in an observed signal.

### ㊺ 2nd FUNC

Key mainly selecting for B SWEEP, B TRIGGER or VOLTS/DIV VARIABLE.

### ㊻ GUIDE MENU

Displays guide menu.

### ㊼ Numeral Keys

Numeral keys (1 to 0) to select the function.

### ㊽ CURSOR

Two keys control position of CRT Cursors. Cursors are used to select measurement points on the displayed waveform.

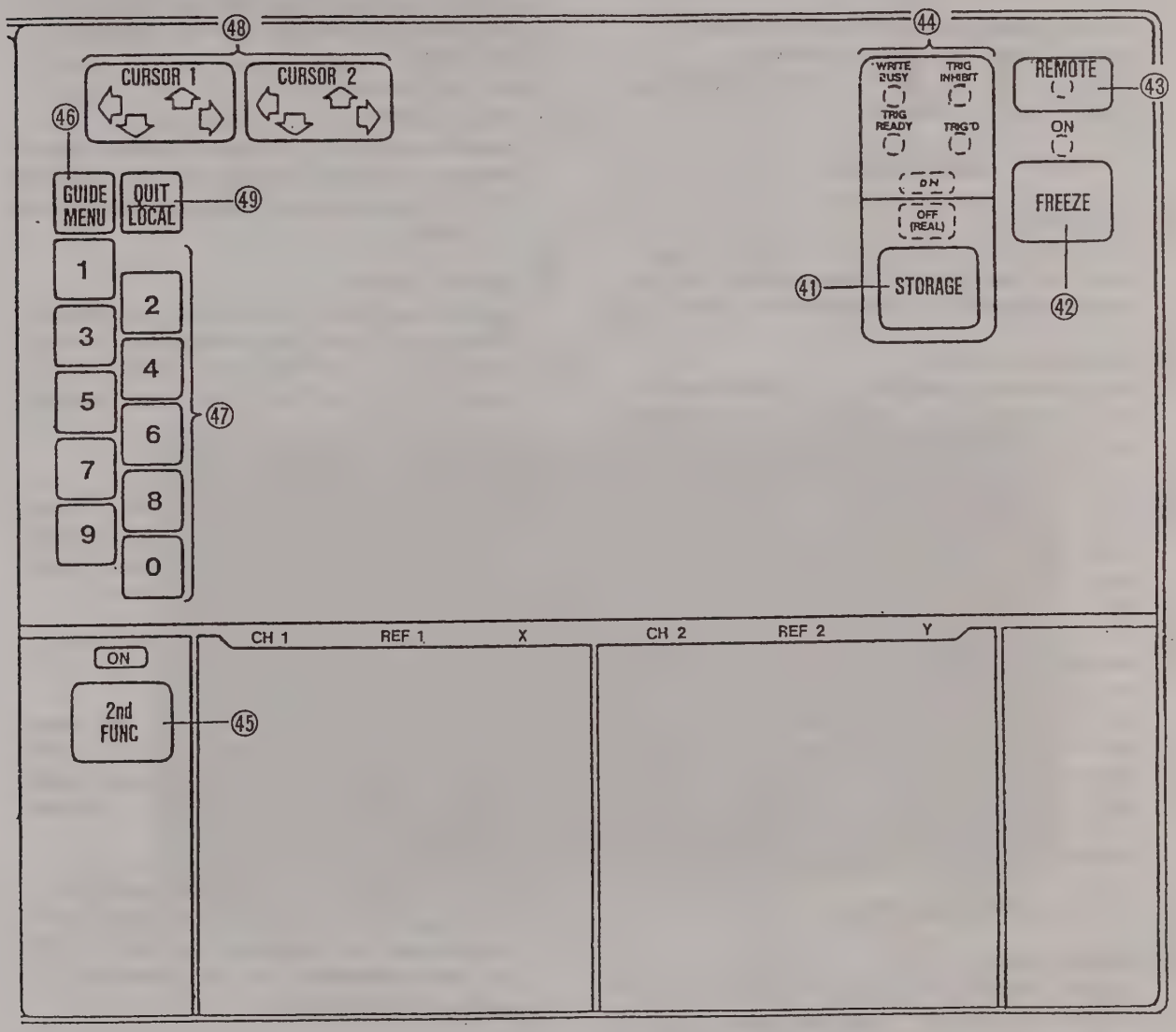
### ㊾ QUIT/LOCAL

Has both functions of QUIT and LOCAL.

**QUIT:** Clears FUNCTIONS selected on GUIDE MENU.

**LOCAL:** Returns the DS-6121 to LOCAL state (a state in which panel operations are effective) from REMOTE state.

Figure 2-1-5. STORAGE, GUIDE MENU and Others



## 2-2 REAR PANEL

### ⑤⓪ REAL SIGNALS — STORAGE SIGNALS
Outputs REAL or STORAGE SIGNALS.
Refer to ⑤① to ⑤④ for REAL SIGNALS and ⑤⑤ to ⑤⑧ for STORAGE.

**REAL SIGNALS**

### ⑤① CH 1 OUTPUT
Bnc connector providing on output signal with an amplitude of approximately 30 mV per each division of displayed CH 1 signal.

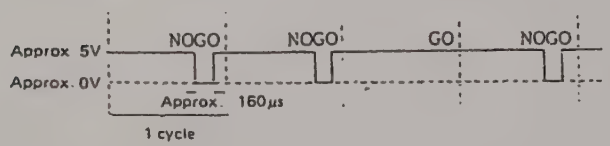
### ⑤② A GATE OUTPUT
Bnc connector providing an approximately 5 V, positive-going square wave coincident with the A Sweep time.

### ⑤③ B GATE OUTPUT
Bnc connector providing an approximately 5 V, positive-going square wave coincident with the B Sweep time.

### ⑤④ Z-AXIS INPUT
Bnc connector used to apply external signals to the Z-axis amplifier to intensity modulate the display. Intensity modulation does not affect the displayed waveshape. Signals with fast rise and fall time provide the most abrupt intensity change. Positive- a 5 Vp-p signal will produce noticeable modulation.

**STORAGE SIGNALS**

### ⑤⑤ GO/NO GO OUT
Outputs GO/NO GO signal. Output voltage is approximately 5 V on the side of GO, and approximately 0 V on the side of NO GO. Output resistance is 3.3 kΩ±20% on the side of GO, and 1 kΩ±20% on the side of NO GO.




### ⑤⑥ PEN Y OUTPUT
Outputs analogue signal for Y-axis of pen recorder. Output voltage is approximately 0.2 V per division. Output resistance is 1 kΩ±20%.

### ⑤⑦ PEN X OUTPUT
Outputs analogue signal for X-axis of pen recorder. Output voltage is approximately 0.2 V per division. Output resistance is 1 kΩ±20%.

### ⑤⑧ PEN UP OUTPUT
Outputs the pen-up signal for pen recorder. Output voltage is approximately 5 V on UP side, and 0 V on DOWN side. Output resistance is 2.9 kΩ±20% on UP side and 600 Ω±30% on DOWN side.

### ⑤⑨ EXT CLOCK INPUT
Inputs the external clock signal. Clock signal which is less than 0.6 V at low level, and over 2.7 V at high level. Input resistance voltage is ±50 V MAX.

**OTHERS**

### ⑥⓪ CAL 10 mA
Current at 1 kHz, 10 mA flows in the direction of arrow mark (from right to left) at the current loop terminal. Current output is used for check and correction of current probe.

### ⑥① ⏚ (Grounding terminal for protection)
It is used for protection. When power socket is not made of three-wire system, be sure to make grounding of this terminal for preventing the danger.

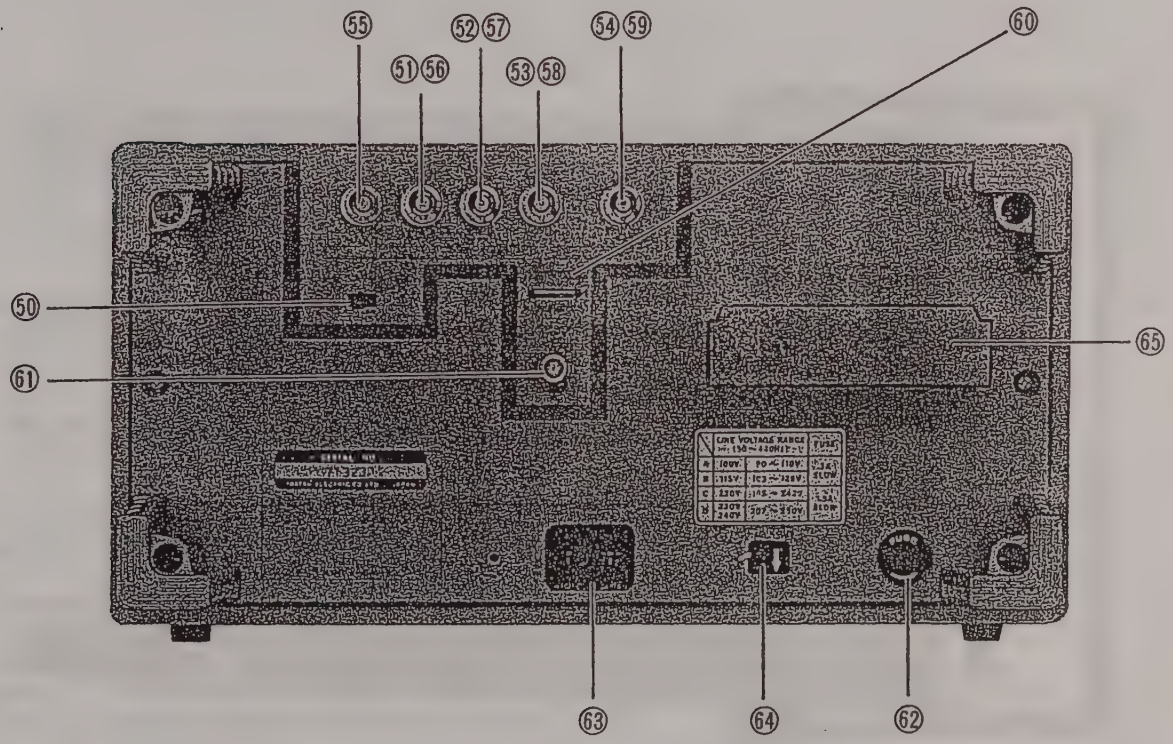
### ⑥② FUSE
This is a fuse holder. After change of line, voltage be certain correct, slow-blow fuse of 3 A or 1.5 A is used (see line voltage range/fuse chart).

### ⑥③ AC LINE INPUT
Connected a power-supply cord.

⑭ A-B-C-D (Voltage changer plug)
To select desired line voltage, position the arror mark of changeover plug to either one of A • B • C • D. Refer to the list labeled "line voltage range". Before changing line voltage, be sure to disconnect the power cord and to dismount the rear panel.
cord and to dismount the pack panel.

⑮ Hole for Options
Inserts the GP-IB pack or the RS-232-C pack.

Figure 2-2. Rear Panel



## 2-3 BOTTOM

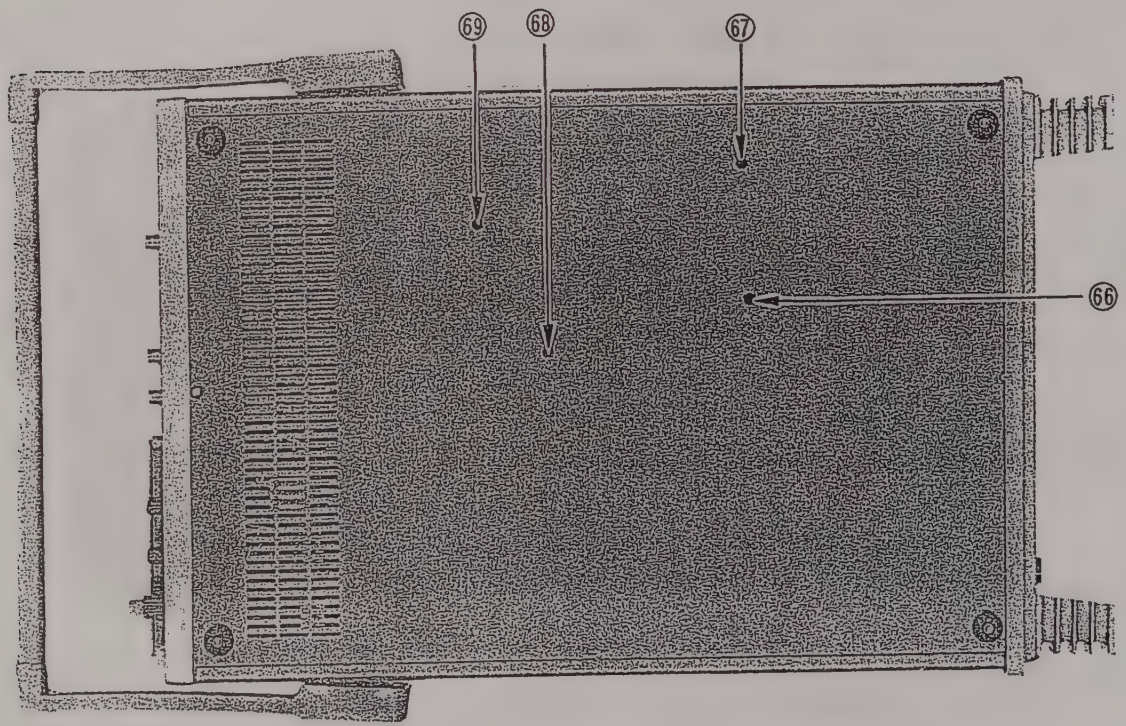
⑥⑥ CH 1 GAIN
Adjusts CH 1 vertical deflection factor.

⑥⑦ CH 2 GAIN
Adjusts CH 2 vertical deflection factor.

⑥⑧ CH1 5 mV BAL
Adjusts for minimizing the vertical movement of the trace with CH 1 VOLTS/DIV control set to 10 mV/5 mV position.

⑥⑨ CH2 5 mV BAL
Adjusts for minimizing the vertical movement of the trace with CH 2 VOLTS/DIV control set to 10 mV/5 mV position.

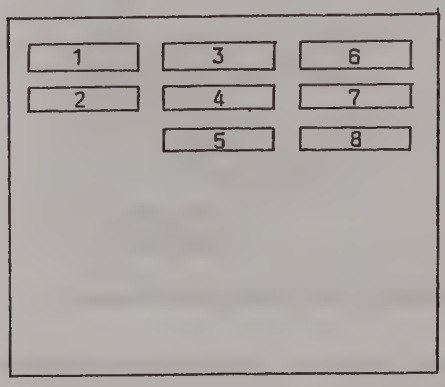
Figure 2-3. Bottom



## 2-4 READOUT

### 2-4-1 Display of Setting Control Values from Panel

Control setting values selected on the front panel are displayed in the following positions on the CRT screen.




1. CH 1 VOLTS/DIV
   Displays the voltage per division.
   - When CH 2 is selected, the value is displayed with "(  )".
   - When UNCAL is selected, the value is displayed with " > ".

2. CH 2 VOLTS/DIV
   Same as in CH 1.

3. A TRIGGER LEVEL
   A TRIGGER LEVEL is displayed in the range between +100% (upper limit) and -100% (lower limit).
   - When B SWEEP is selected, the value is displayed with "(  )".

4. HOLDOFF
   HOLDOFF TIME is displayed in the range between 100% (upper limit) and 0% (lower limit).
   - Nothing is displayed when the HOLDOFF TIME is 0%.

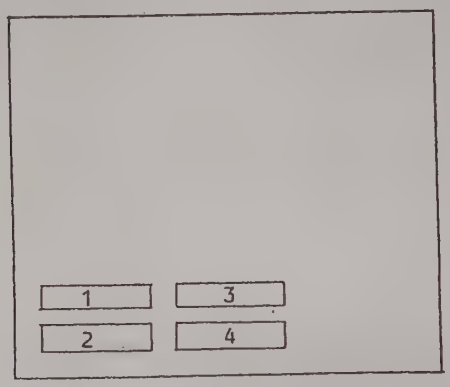
6. A TIME/DIV
   Sweep time per DIV is displayed.
   - When UNCAL is selected, the value is displayed with " > ".

7. DELAY TIME
   DELAY TIME MULTI is displayed in the range between 0.200 and 10.238.

8. B TIME/DIV
   Sweep time per DIV is displayed.

## 2-4-2 Display of REF

Displays when setting REF (selectable only in STORAGE mode).




1. REF 1 Deflection Factor
   Displays the voltage per DIV when the waveform is saved.

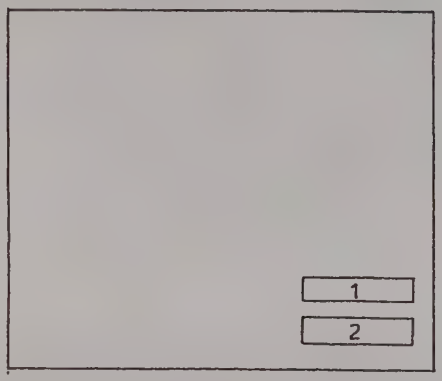
2. REF 2 Deflection Factor
   Same as in REF 1 Deflection Factor.

3. REF 1 Sweep Time
   Displays the sweep time per DIV in A SWEEP or B SWEEP when the waveform is saved.

4. REF 2 Sweep Time
   Same as in REF 1 Sweep time.

## 2-4-3 Cursor Measurement Value Display

Displays when the measurement by cursors is selected.

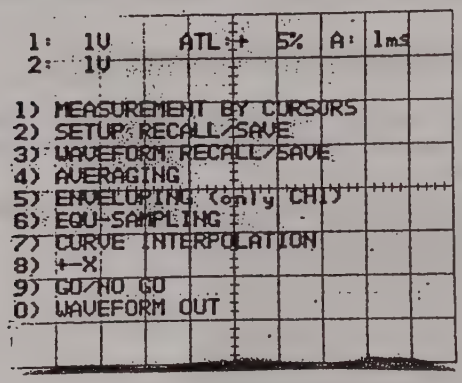



| Measured Items \ Displayed Position | 1 | 2 |
|---|---|---|
| ΔVoltage | CH 1 (V) | CH 2 (V) |
| Voltage Ratio | CH 1 (dB, %) | CH 2 (dB, %) |
| ΔTime | Time(s) | Frequency (Hz) |
| Phase | — | Phase (degree) |
| ΔV on WAVEFORM | CH 1 (V) | CH 2 (V) |

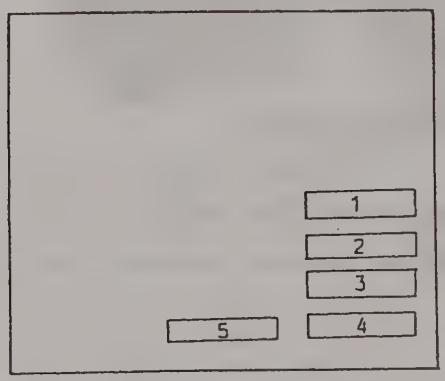
When UNCAL is selected for Y-AXIS Deflection Factor or SWEEP TIME, the value is displayed with " > ".

## 2-4-4 Guide Menu Display

When [GUIDE MENU] key is pressed, the Guide Menu is displayed.




FUNCTION selected in the Guide Menu is displayed as in the following.




1. GO/NO GO
   Displays IN or OUT RANGE together with evaluated results.

2. + - X
   Displays the type of calibration.

3. AVERAGING

4. CURVE INTERPORATION

5. ENVELOPING or EQU-SAMPLING

## 2-5 OPERATION OF THE HANDLE AND REMOVAL OF THE ACCESSORIES BAG

### 2-5-1 Operation of the Handle

The carrying-handle of the DS-6121 can be unlocked if the rotary part (root) of the handle is pressed inwards (in the arrow direction) as shown in Figure 2-5-1 (a).

If both the right and left ends are pushed, they can be unlocked together, and the handle can be turned as it is.

If the rotary part is released, the handle is automatically locked.

The handle can be positioned as desired for carrying (as shown in Figure 2-5-1 (a)) or as a stand for signal observation (as shown in Figure 2-5-1 (b)).

Fold the handle back as shown in Figure 2-5-1 (c), if possible, when storing the DS-6121.

### 2-5-2 Removal of the Accessories Bag

When removing the accessories bag from the upper cover of the DS-6121, remove the four screws as shown in Figure 2-5-2.

Use the same screws for mounting the accessories bag on the upper cover again.

Figure 2-5-1. How to Place the DS-6121 and Use the Handle

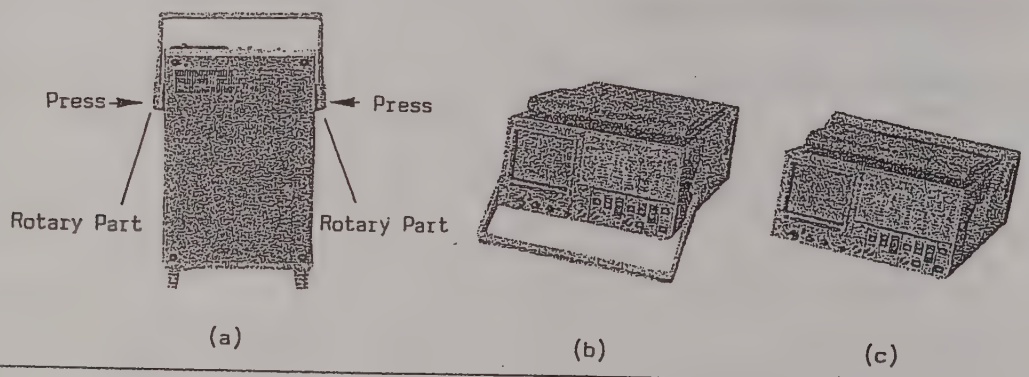
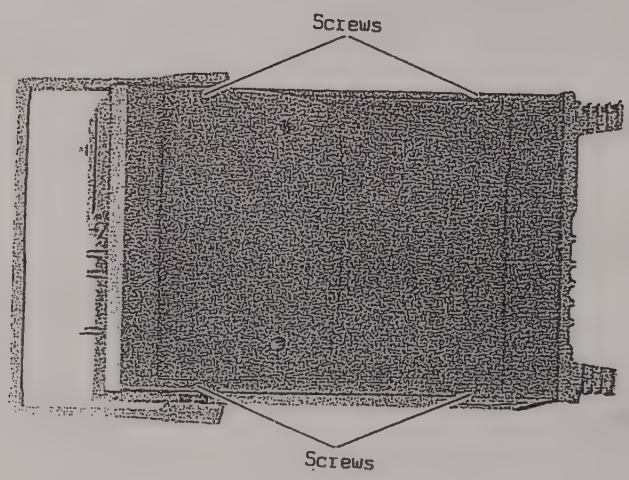



Figure 2-5-2. Removal of the Accessories Bag

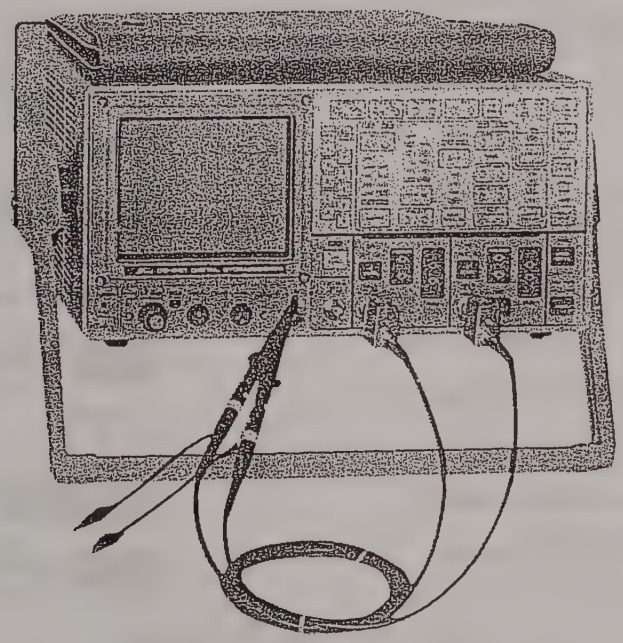


# Section 3 Operating Information

There are two ways for operation: one is operated by keys on the front panel and the other is controled by GP-IB.

In this section described are the operating procedures under CAL (except 3-7-4 to 3-7-9) input using the attached probe SS-0012R. As to GP-IB see Section 4.

Figure 3. Connection of Probe



## Operating Guide

This section is as follows


3-1 POWER ..... 3 – 4

..... 3 – 4

3-2 VERTICAL SYSTEM ..... 3 – 6

..... 3 – 6

..... 3 – 6

..... 3 – 7

..... 3 – 8

..... 3 – 8

..... 3 – 9

..... 3 – 9

3-3 TRIGGERING ..... 3 – 10

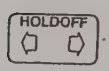
..... 3 – 10

..... 3 – 11

TV signal measurement ..... 3 – 12

..... 3 – 13

..... 3 – 14

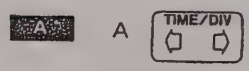


..... 3 – 15

3-4 HORIZONTAL SYSTEM ..... 3 – 16

..... 3 – 16

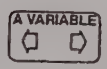
..... 3 – 16



..... 3 – 16

ROLL MODE ..... 3 – 16

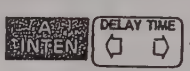
EXT CLOCK Setting ..... 3 – 17



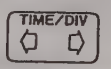
..... 3 – 18

..... 3 – 18

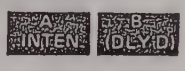
..... 3 – 18



..... 3 – 19



..... 3 – 20



..... 3 – 20

..... 3 – 20

3-5 STORAGE ..... 3 – 21

..... 3 – 21

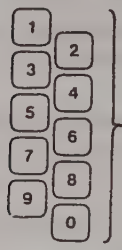
..... 3 – 22

MAGNIFICATION ..... 3 – 23

3-6 X-Y OPERATION ..... 3 – 24

## 3-7 GUIDE MENU


GUIDE MENU ..... 3 – 26




..... 3 – 26

Guide Menu Tree ..... 3 – 27

Usage Range ..... 3 – 28

Error Messages ..... 3 – 28

Multiple-usage of Guide Menu ..... 3 – 29

Quit of Guide Menu ..... 3 – 29

QUIT LOCAL ..... 3 – 29

1) MEASUREMENT BY CURSORS

CURSOR 1 CURSOR 2 ..... 3 – 30

Δ VOLTAGE ..... 3 – 32

VOLTAGE RATIO ..... 3 – 33

Δ TIME ..... 3 – 34

PHASE ..... 3 – 35

ΔV ON WAVEFORM ..... 3 – 36

2) SETUP ..... 3 – 37

SAVE ..... 3 – 38

RECALL ..... 3 – 40

3) WAVEFORM RECALL/SAVE ..... 3 – 42

SAVE ..... 3 – 42

RECALL ..... 3 – 44

Observations of Four Phenomena ..... 3 – 45

MOVE ..... 3 – 46

Observation of Four Phenomena ..... 3 – 47

4) AVERAGING ..... 3 – 48

5) EQU-SAMPLING ..... 3 – 50

6) CURVE INTERPOLATION ..... 3 – 51

7) +-X ..... 3 – 52

8) GO/NO GO ..... 3 – 54

Definitions of IN-RANGE and OUT-RANGE ..... 3 – 54

CURSORS ..... 3 – 56

WAVEFORMS ..... 3 – 58

9) WAVEFORM OUT ..... 3 – 60

X–Y Recorder ..... 3 – 60

Plotter setting and others ..... 3 – 62

Example for Constructing ..... 3 – 63

## 3-1 POWER TURNING-ON AND CHECK OF INITIAL STATE

### Power Turn-on

① Turn the power on, observe the "caution" item described right.

### Check of Internal Operation

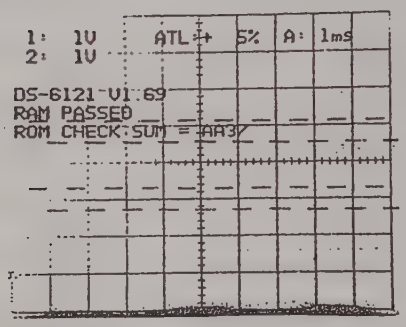
After the power is turned on, check whether the internal operation is normal.

② Adjust A and CHARACTER INTENSITY

③ Adjust FOCUS.

④ Check the waveforms on the CRT screen are as shown in Figure 3-1-1.

Figure 3-1-1. Check of Initial State




<Note> The numbers of version and ROM may change

**RAM Check**

Writes and reads the contents of the memory, and if they do not coincide. "FAULT" is displayed. When they do, "RAM PASSED" is displayed.

**ROM Check**

Performs CHECK-SUM and displays SUMMING DATA in hexadecimal of four digits.

**A and Character Intensity**

The knobs for individually changing the intensity of waveforms and of characters and cursors are located on the bottom of the CRT.

Photos taken in the REAL mode by single sweep may show waveforms with missing parts. In that case, the missing parts won't be shown by turning CHARACTER INTEN fully counterclockwise.

**Caution**

**Check line voltage.**

*Check the line voltage before connecting the power cord. By setting the line voltage switch plug on the rear panel, the DS-6121 can be used with the power voltages listed in the following:*

| *Set Position* | *Center voltage* | *Voltage Range* | *Fuse* |
|---|---|---|---|
| *A* | *100 V* | *90 - 110 V* | *3A slow - blow* |
| *B* | *115 V* | *103 - 128 V* | |
| *C* | *220 V* | *195 - 242 V* | *1.5 A slow - blow* |
| *D* | *230/240 V* | *207 - 250 V* | |

*Please note that using the system at voltages outside of the specified range may cause damage:*

**Use the supplied power cord.**

*Ground the protective grounding terminal to the earth. When the line voltage is supplied from a two-wire outlet using a three-wire to two-wire convertion connector, never fail to ground the protective grounding terminal to ensure safety.*

## Initial State

### Operation

| | |
|---|---|
| Write | Stop state |
| GP-IB | Local state |
| Recorder Output | Stop state |
| GO/NO GO Output | Stop state |

### Measurement Conditions

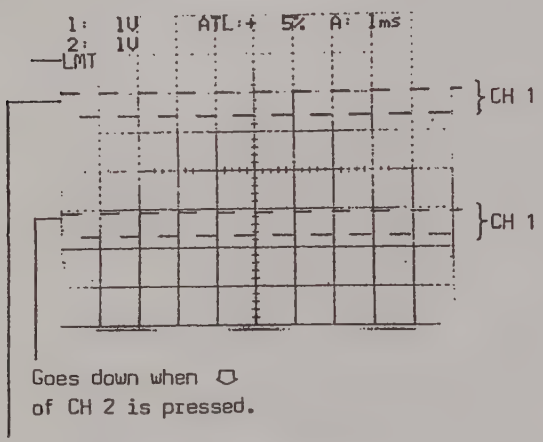
| | |
|---|---|
| Vertical System | |
| COUPL | AC (for both CH 1 and CH 2) |
| POSITION | CH 1 1 DIV upper than midrange<br>CH 2 1 DIV lower than midrange |
| VOLTS/DIV | 0.1 V/DIV (for both CH 1 and CH 2) |
| VARIABLE | CAL (for both CH 1 and CH 2) |
| CH 2 POLAR | No INV |
| MODE | ALT |
| TRIGGERING | |
| A SOURCE | CH 1 |
| A COUPLING | AC |
| A SLOPE | + |
| A LEVEL | +5% |
| Horizontal System | |
| MODE | AUTO |
| HORIZ DISPLAY | A |
| A TIME/DIV | 1 ms/DIV |
| A VARIABLE | CAL |
| STORAGE | OFF (REAL) |

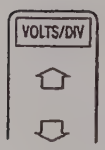
## 3-2 VERTICAL DEFLECTION SYSTEM

### Setting

When the ⇧ of CH 1 is pressed, the trace of CH 1 will go up; when the ⇩ of CH 1 is pressed, it will go down. The same results for CH 2.

When the trace reaches the set ultimate position, "LMT" will blinks at the upper left corner of the CRT.

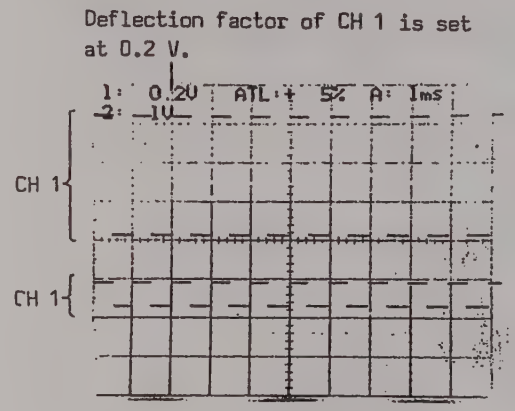



### Setting

Setting is possible when VOLTS/DIV is illuminated. The deflection factor increases when ⇧ is pressed, and reaches the final value 1 mV/DIV, decrease when ⇩ is pressed and reaches the final value 5 V/DIV.

When the final set value is reached, "LMT" blinks on the upper left corner of the CRT.

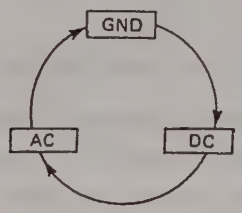



### Probe sense

If the supplied SS-0012R probe is used, vertical deflection factor display is automatically switched to 10:1.

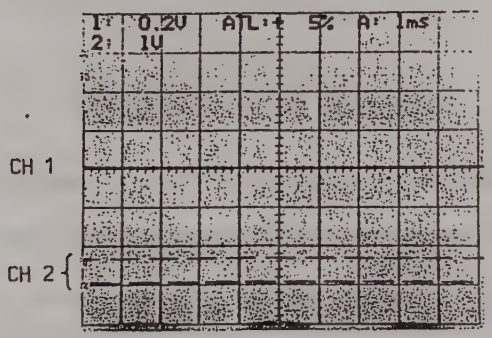
## V COUPL Setting

Every time V COUPL is pressed, the setting will be switched as shown in the following.

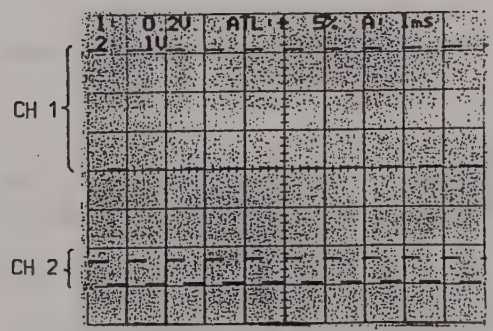



Shown below is the waveform at each V COUPL setting of CH 1.

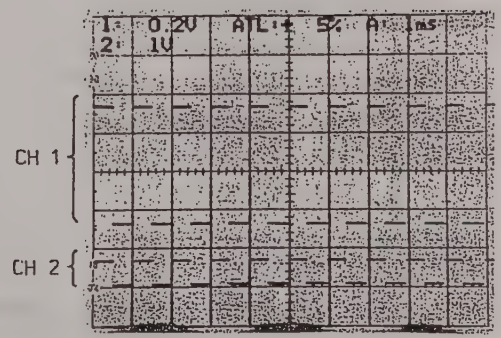
**1) With GND to set the gound level.**




**2) Observe with DC .**




**3) Observe with AC .**



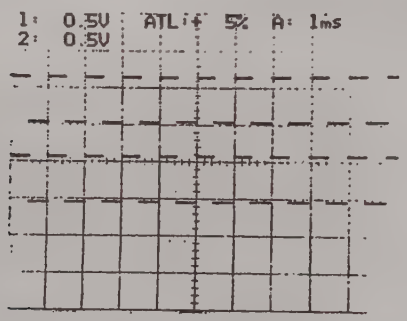
## MODE Setting

Every time MODE key is pressed, the mode is switched as in the following.

**At storage off (real)**

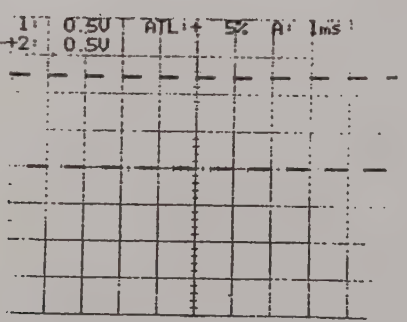
When TIME/DIV is set at faster than 0.1 s.

(1) Observe in ALT mode




(2) Observe the waveform in ADD (CH 1 + CH 2) mode

Indicates the CH 1 + CH 2

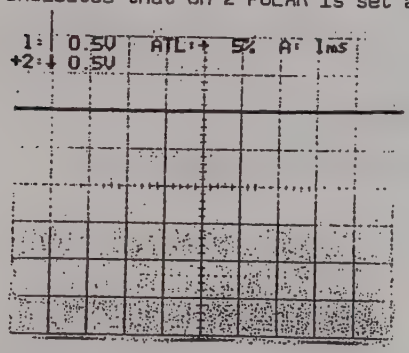



## CH 2 POLAR Setting

Every time CH 2 POLAR key is pressed, CH 2 POLAR is switched. When INV glows, CH 2 polarity is inverted.

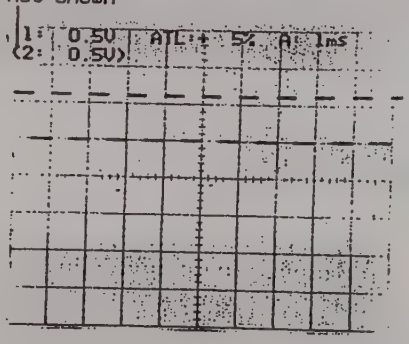
(3) Observe with the same settings as in (2), but CH 2 POLAR set at INV (CH 1 - CH 2).

Indicates that CH 2 POLAR is set at INV




(4) Observe the waveform of (1) in CH 1 mode.

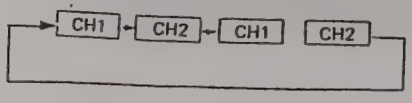
Indicates that the waveform of CH 2 is not shown



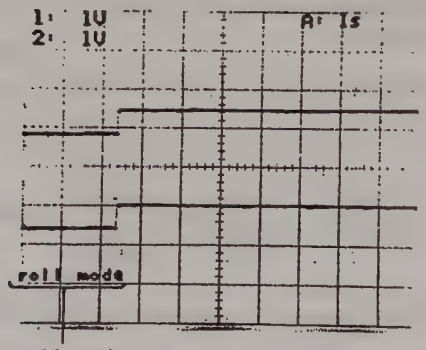

**Roll Mode**

When TIME/DIV is set to slower than 0.2 s (roll mode), the MODE is switched as in the following.

As to ROLL mode, see TIME/DIV setting.



(5) Observe with the setting of TIME/DIV at 1 s



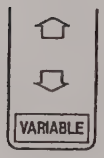

roll mode

**At storage on**

With STORAGE ON, the mode is switched as in the following:

CH1 → CH2 → CH1 CH2 → CH1 CH2 REF

As to REF, see GUIDE MENU (3).

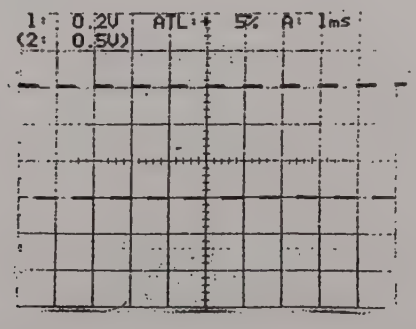



**Setting**

When [2nd FUNC] is switched to ON, VOLT/DIV goes off, and [VARIABLE] glows; setting of VARIABLE is now possible.

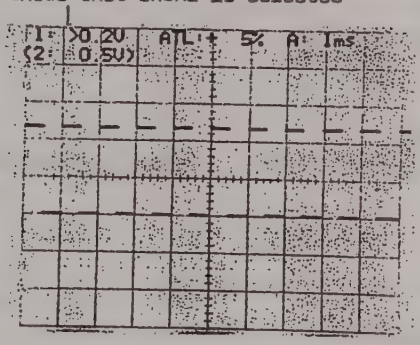
When ⇩ is pressed, the deflection factor decreases and UNCAL-lamp glows. when it is kept pressed to reach the final value, "LMT" blinks at upper left corner of the CRT. When ⇧ is pressed, the deflection factor increases.

1) When VARIABLE is not set

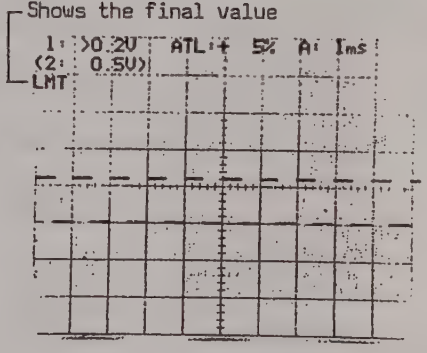



2) When VARIABLE is set

Shows that UNCAL is selected




Shows the final value




[BAND WIDTH] **Setting**

Every time [BAND WIDTH] key is pressed, the bandwidth 20 MHz limiter is switched between ON and OFF.

## 3-3 TRIGGERING

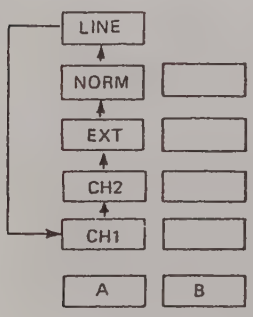
### SOURCE Setting

#### A SOURCE

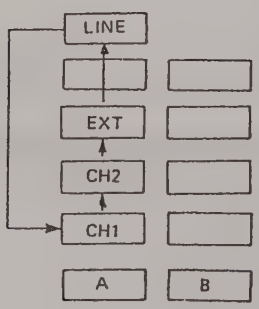
When [A] is glowing, A SOURCE can be set.

Every time [SOURCE] key is pressed, it is switched as in the following.

- At [STORAGE] OFF




- At [STORAGE] ON



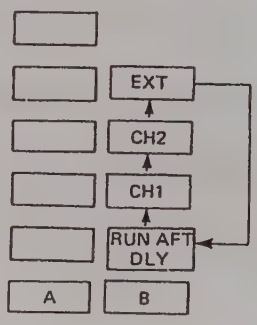

#### B SOURCE

When the following setting is made. [A] goes off and [B] glows and the setting of B Source becomes possible.

[2nd FUNC] : [ON]

[HORIZ DISPLAY] : [A INTEN], [B (DLY'D)], or [B (DLY'D) / A INTEN] (STORAGE OFF)

Every time [SOURCE] is pressed, it is switched as in the following.



## COUPLING Setting

### A COUPLING

Setting is possible when [A] is glowing.

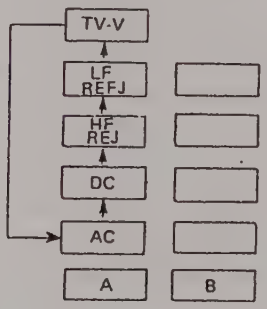
Every time [COUPLING] key is pressed, it is switched as in the following.

1) [HORIZ DISPLAY] : [A]

or

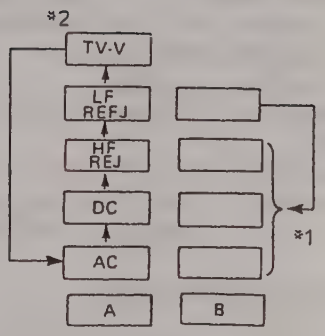
[HORIZ DISPLAY] : [A INTEN], [B (DLY'D)], [B (DLY'D)] / [A INTEN]

[SOURCE] [B] : [RUNAFT DLY]




2) [HORIZ DISPLAY] : [A INTEN], [B (DLY'D)], [B (DLY'D)] / [A INTEN]

[SOURCE] : [CH1], [CH2], [EXT]




*1 Final setting of B.

*2 If TV-V is selected for A, TV-H is set for B.

### B COUPLING

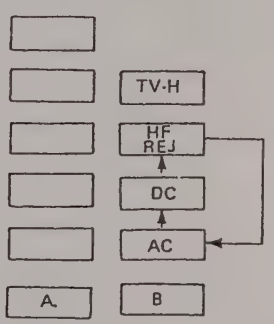
When the following setting is made, [A] of [COUPLING] goes off and [B] glows, and setting of B COUPLING is enabled.

[2nd FUNC] : [ON]

[HORIZ DISPLAY] : [A INTEN], [B (DLY'D)], [B (DLY'D)] / [A INTEN]

[SOURCE] [B] : [CH1], [CH2], [EXT]

Every time [COUPLING] key is pressed, it is switched as in the following.

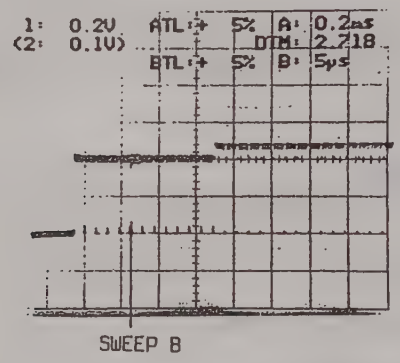


TV Signal Measurement

① Described below is a measurement example that applies when the following setting is made under TV signal input.

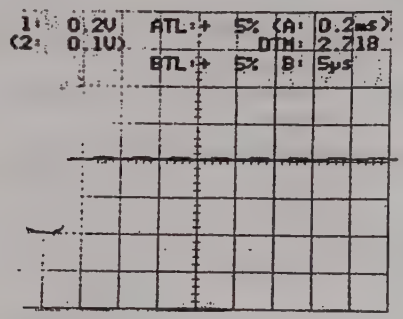
| | |
|---|---|
| HORIZ DISPLAY | A INTEN |
| A SOURCE | CH 1 |
| A SLOPE | – |
| A COUPLING | TV-V |
| B COUPLING | TV-H is set automatically by setting A COUPLING to TV-V |

1) Observe in A INTEN mode




② Set HORIZ DISPLAY to B (DLY'D), the following is displayed.

2) Observe in B (DLY'D)

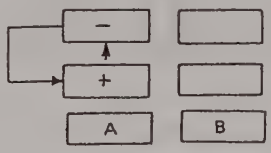


## SLOPE Setting

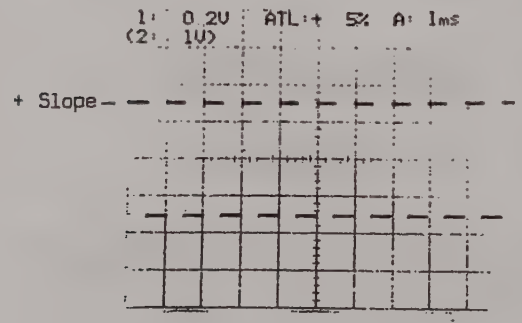
### A SLOPE

Setting is possible when [A] is glowing.

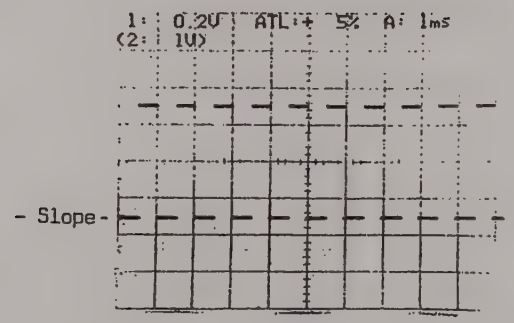
When the [SLOPE] key is pressed, it is switched between "+" and "-".




1) "+" SLOPE of A




2) "-" SLOPE of A




### B SLOPE

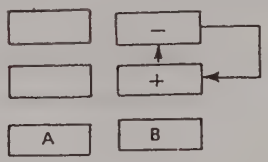
When the following setting is made, [A] of [SLOPE] goes off and [B] glows, and setting of B SLOPE is enabled.

[2nd FUNC] : [ON]

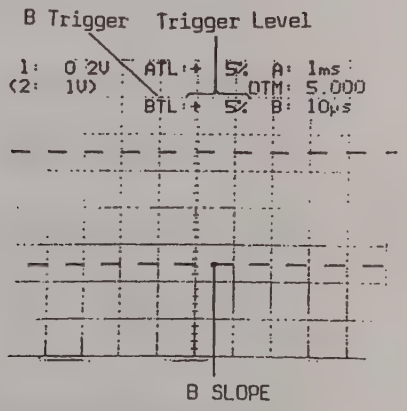
[HORIZ DISPLAY] : [A INTEN], [B (DLY'D)], [B (DLY'D)] / [A INTEN]

[SOURCE] [B] : [CH1], [CH2], [EXT]

Every time [SLOPE] key is pressed, it is switched between "+" and "-".




3) "-" SLOPE of B



## LEVEL Setting

Every time ⇧ of [LEVEL ⇩ ⇧] key is pressed, the level increases and reaches the final value +100%.

Each time ⇩ of [LEVEL ⇩ ⇧] key is pressed, the level decreases and reaches the final value -100%.

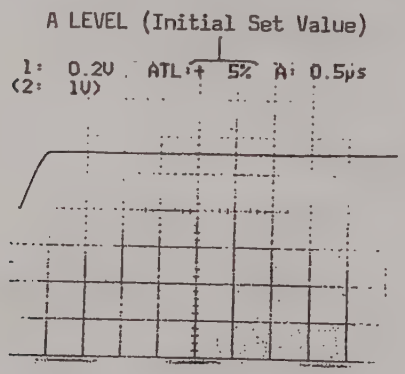
When the final value is reached, "LMT" blinks at upper left corner of the CRT.

### A LEVEL

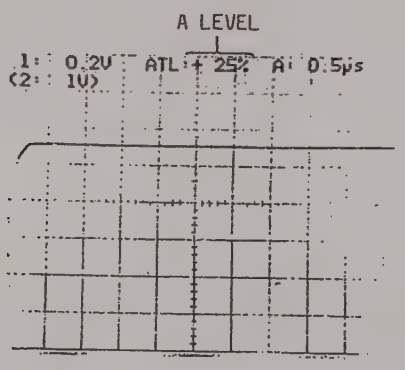
Setting is possible when [A] is glowing.

Described below are measurement examples when A TIME/DIV is set at 0.5 µs.

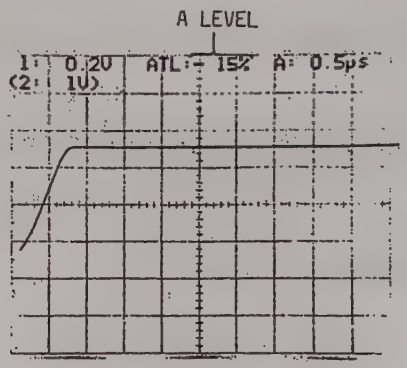
1) Initial Setting




2) A LEVEL is set at +25% by pressing ⇧




3) A LEVEL is set at -15% by pressing ⇩




### B LEVEL

When the following setting is made, [A] goes off and [B] glows, and setting of B LEVEL is enabled.

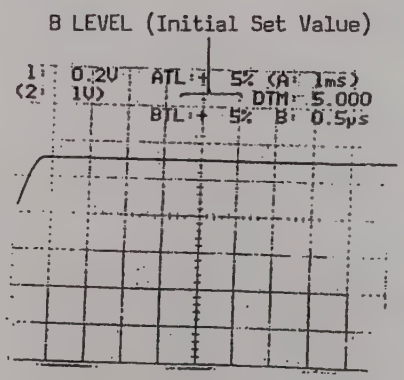
[2nd FUNC] : [ON]

[HORIZ DISPLAY] : [A INTEN], [B (DLY'D)], [B (DLY'D)] / [A INTEN]

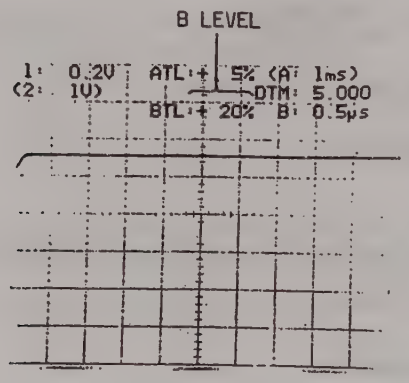
[SOURCE] [B] : [CH1], [CH2], [EXT]

Described below are measurement examples when A TIME/DIV is set at 1 ms, and B TIME/DIV is set at 0.5 µs.

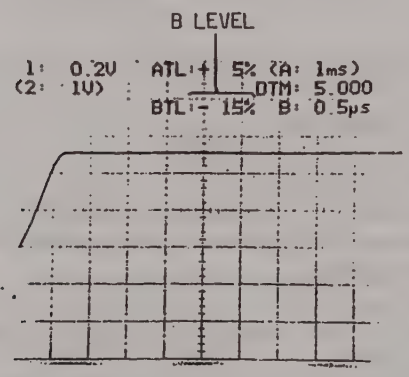
1) Initial Setting



2) B LEVEL is set at to +20% by pressing ⇧




3) B LEVEL is set at -15% by pressing ⇩



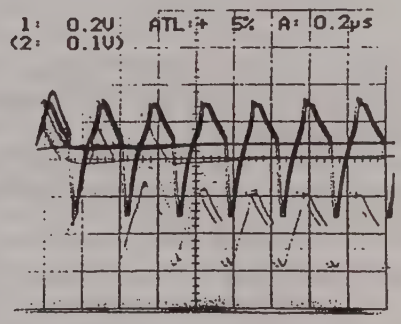

HOLDOFF ⇦ ⇨ **Setting**

When ⇦ is pressed, holdoff time is increased and reaches the set ultimate value of 100%. When ⇨ is pressed, holdoff time is decreased and reaches the final value 0%, at which time nothing is displayed on the CRT.

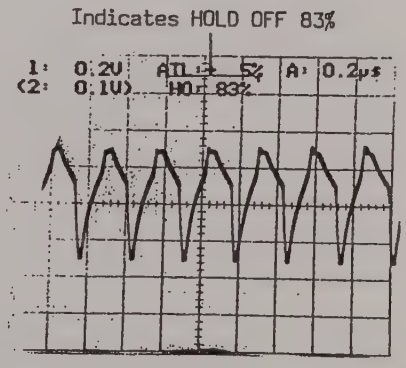
When the final value is reached, "LMT" blinks at the upper left corner of the CRT.

Below is an example with a periodic signal (TV signal) input.

1) HOLD OFF 0%



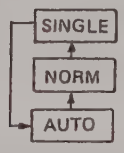

2) HOLD OFF 83%



## 3-4 HORIZONTAL SYSTEM

### SWEEP MODE Setting

Every time [SWEEP MODE] key is pressed, the mode is switched as in the following.



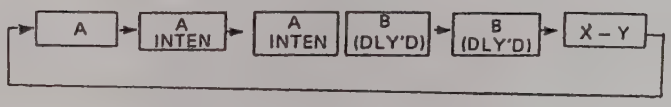

**AUTO:** When ⇩ or ⇧ of LEVEL is kept pressed in triggered state, triggering is disturbed to produce an automatic state.
**NORM:** When ⇧ or ⇩ of LEVEL is kept pressed in triggered state, triggering is disturbed and further pressing stops the sweep.

**SINGLE:** The sweep stops. Every time [SINGLE RESET] key is pressed, sweep is done only once.

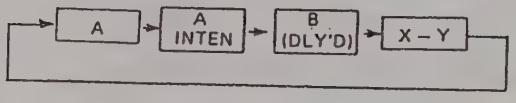
### HORIZ DISPLAY Setting

Every time [HORIZ DISPLAY] key is pressed, it is switched as in the following.

STORAGE OFF (REAL)




STORAGE ON




#### A Operation

### [A] [TIME/DIV ⇦ ⇨] Setting

Every time ⇨ is pressed, sweep time becomes faster in a 1-2-5 sequence and reaches the final value 20 ns/DIV.

Every time ⇦ is pressed, sweep time slows down in a 1-2-5 sequence and reaches the final value 10 s/DIV.

When the final value is reached, "LMT" blinks at the upper left corner of the CRT.

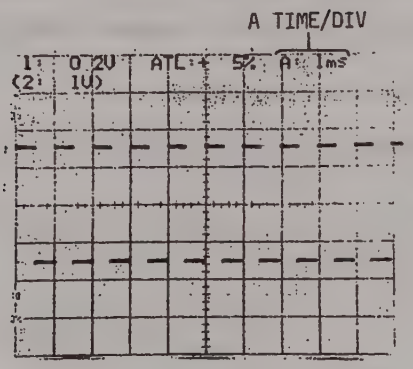
**ROLL MODE Setting**

When using in ROLL mode, the following setting should be made.

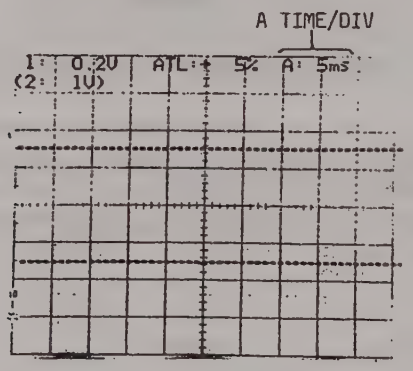
| | |
|---|---|
| STORAGE | OFF (REAL) |
| HORIZ DISPLAY | A |
| TIME/DIV | Slower than 0.2 s/DIV |

If the waveform is to be frozen, switch [FREEZE] to ON.

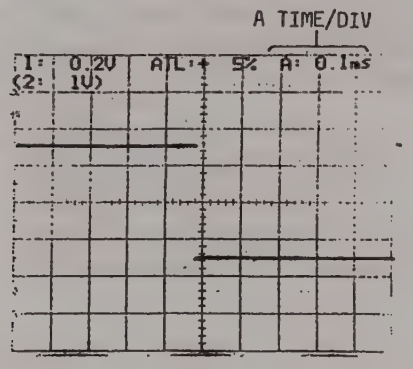
1) Sweep time of initial state




2) When seep time is increased




3) When sweep time is decreased




**EXT CLOCK Setting**

If TIME/DIV is set to EXT in the STORAGE mode, waveforms can be triggered in by external clocks.

If a clock input pause continues longer than about 300 ms, the message NO CLOCK is displayed on the CRT screen.

If a clock slower than 300 ms is input, the message NO CLOCK blink synchronously with the external clock, but this does not adversely affect storage operation at all.

The input terminal is located on the rear panel. Set the STORAGE-REAL select switch on the rear panel to the STORAGE position.

**ROLL mode**

When an input signal is written with a clock repeated slowly (in the slow range of TIME/DIV), it takes considerable time to complete write operation, and observation of input signals during that period is not possible. The instrument solves such trouble by employing ROLL mode in the range 0.2 s to 10 s/DIV.

In ROLL mode, each time a clock writes data of one word-length, the newest data are displayed at the right end of the CRT. Each time subsequent data are inputted, the previous data is moved by one word-length towards the left side of the CRT. Input signal can thus be confirmed upon writing.

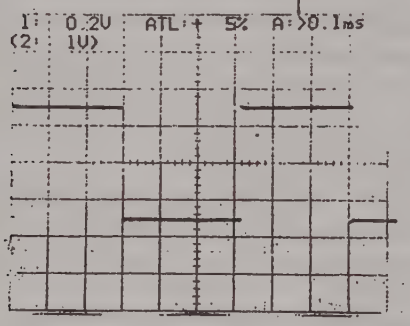
## A VARIABLE ◁ ▷ Setting

When ◁ of A VARIABLE is pressed, the sweep time decreases, and UNCAL glows. When it is further pressed tillthe sweep time reaches the final value, "LMT" blinks at the upper left corner of the CRT.

When ▷ is pressed, the sweep time is decreased. When the sweep time reaches the CAL state. UNCAL goes off and "LMT" blinks at the upper left corner of the CRT.

1) Setting of VARIABLE

Shows that it is in UNCAL state




## POSITION ◁ ▷ FINE ◁ ▷ (Horizontal Position) Setting

When ◁ of POSITION ◁ ▷ or FINE ◁ ▷ is pressed, the trace moves towards left, and when ▷ is pressed, towards right.

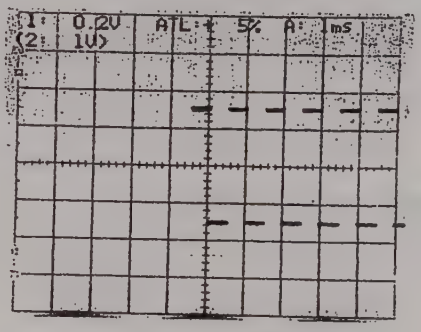
POSITION ◁ ▷ key is used for coarse and FINE ◁ ▷ for fine adjustment.

When the trace reaches the final position, "LMT" blinks at the upper left corner of the CRT.

## X 10 MAG Setting

Every time X 10 MAG key is pressed, magnification is switched between on and off.

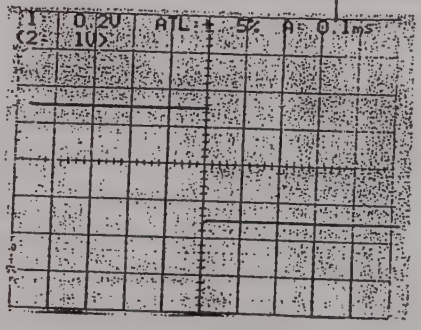
1) ×10 MAG OFF




When X 10 MAG is pressed with the setting above, the signal is horizontally magnified from the center of the CRT.

2) ×10 MAG ON

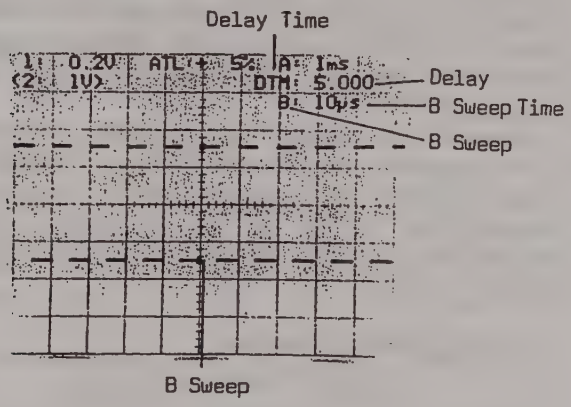
Sweep time is multiplied by 10



## A INTEN Operation

From state 1) of [ A ], set at A INTEN.

1) A INTEN




B SOURCE Setting when A INTEN and STORAGE ON are selected

Even when B TRIGGER SOURCE is set at CH 1, CH 2, or EXT, TRIGGERED DELAY is not performed and works just as when RUNS AFTER DELAY is selected. However, when B DLY'D is set, TRIGGERED DELAY is performed.

**Caution**

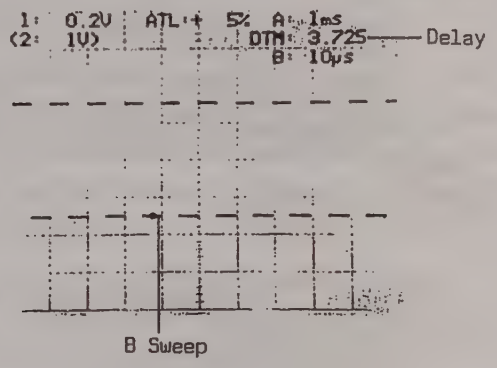
**B SOURCE Setting when A INTEN and STORAGE ON are selected**

*Even when B TRIGGER SOURCE is set at CH 1, CH 2, or EXT, TRIGGERED DELAY is not performed and works just as when RUNS AFTER DELAY is selected. However, when B DLY'D is set, TRIGGERED DELAY is performed.*

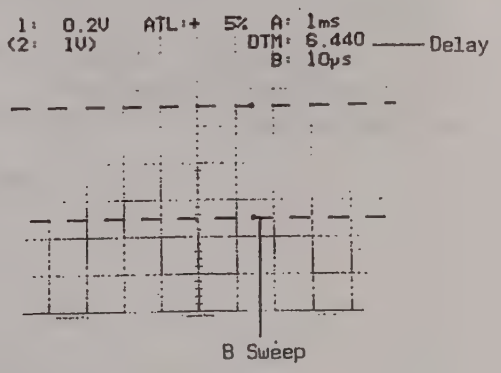
DELAY TIME ⇦ ⇨ Setting

When ⇨ is pressed, delay time increases and reaches the ultimate value of 10.238. When ⇦ is pressed, the delay time decreases and reaches the final value 0.200. When the final value is reached, "LMT" blinks at the upper left corner of the CRT.

2) Decrease delay time




3) Increase delay time



## [B] [TIME/DIV] Setting

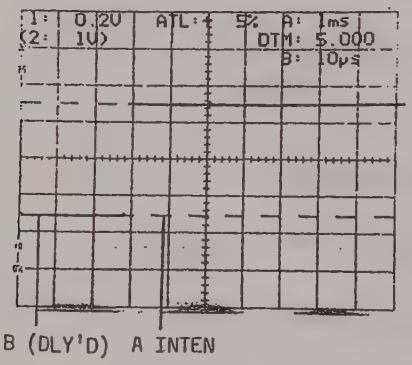
When [2nd FUNC] is switched to ON, [A] [TIME/DIV] goes off and B glows, and setting of B sweep is enabled.

When ⇨ is pressed, the sweep becomes fast, and when ⇦ is pressed, slowed down. When the sweep time reaches the final value, "LMT" blinks at the upper left corner of the CRT.

### A INTEN & B (DLY'D) Operation

When [B (DLY'D)] & [A INTEN] are selected from state 1) of [A INTEN], waveforms with [A INTEN] and [B (DLY'D)] are displayed superimposed.

1) [A INTEN], [B (DLY'D)]

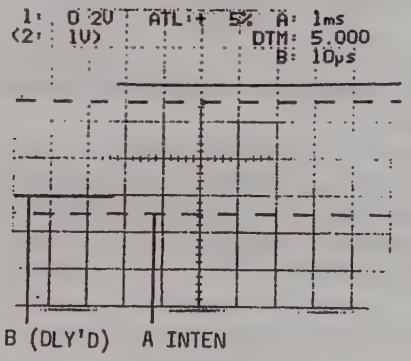



## [TRACE SEPARATION] Setting

when ⇧ of [TRACE SEPARATION] is pressed while the figure shown above is displayed, the waveform with B (DLY'D) moves upwards. When it reaches the final position, "LMT" blinks at upper left corner of CRT.

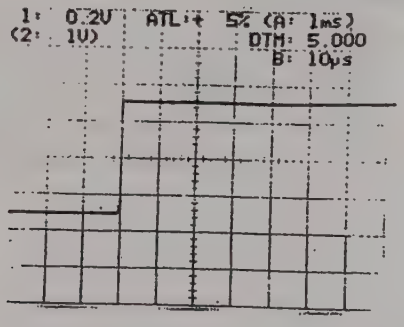
When ⇩ is pressed under the same condition, the waveform with B (DLY'D) moves downwards. When it reaches the position shown in the figure above, "LMT" blinks at the upper left corner of the CRT, and the waveform will not move further.

2) TRACE SEPARATION Setting



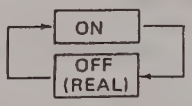

### B (DLY'D) Operation

When [HORIZ DISPLAY] is pressed when 1) [A INTEN] & [B (DLY'D)] are selected, only [B (DLY'D)] glows and only the waveform with S [B (DLY'D)] selected is displayed.



## 3-5 STORAGE

Every time [STORAGE] is pressed, it is switched between ON and OFF (REAL).




**AUTO or NORM**

Repeats write and read operations. If the written waveform is to be left displayed on the CRT, press [FREEZE] to ON . When [FREEZE] is activated, new write operation cannot be conducted, and the stored waveform is kept displayed on the CRT.

**SINGLE**

WRITE operation is conducted only once.

**[FREEZE] Setting**

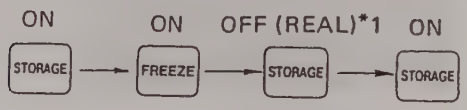
Every time [FREEZE] is pressed, it is switched between on and off.

**Note to FREEZE**

[FREEZE] key is pressed when an inputted signal entered into CH 1 or CH 2 is to be written into memory and the signal is to be stored as it is. When FREEZE is activated, ON glows and the locked state results. In this state, write operation cannot be done even if a new signal is inputted.

**Note on FREEZE Indicator**

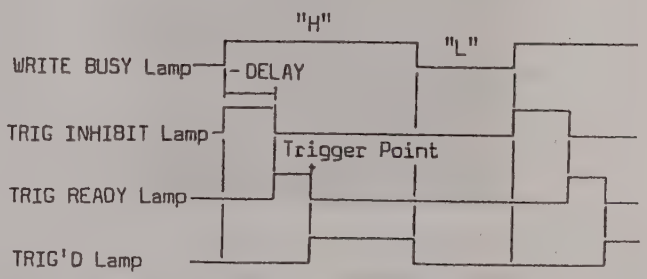
In the following case, FREEZE LED glows even when STORAGE is OFF (REAL).




*1 Even when the STORAGE is in REAL mode, FREEZE LED is glowing.

**Note on STORAGE status indicator.**

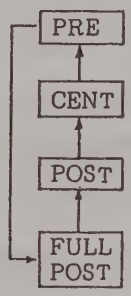
When LEVELs are "H", indicator lamps on the front panel are illuminated.



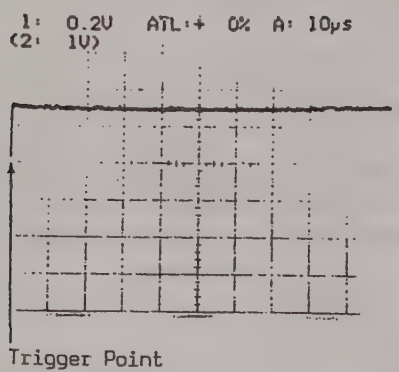
## DATA POSITION Setting

When STORAGE is switched to ON , DATA POSITION is activated.

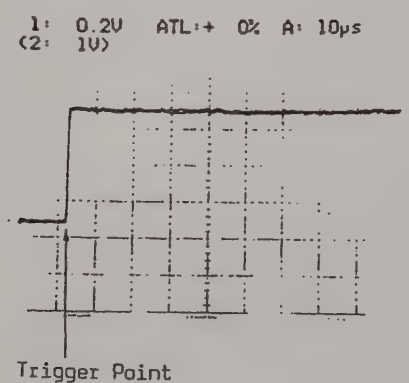
Every time DATA POSITION is pressed, it is switched as in the following.



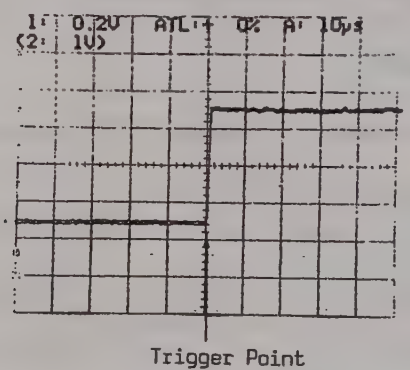

1) FULL POST (DELAY 0)



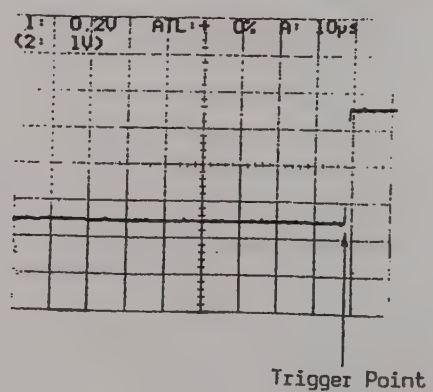

2) POST (DELAY -1/8)




3) CENT (DELAY -4/8)




4) PRE (DELAY -7/8)



## Waveform Magnification

Magnification and reduction are possible in storage mode. Setting range is as follows.

| | |
|---|---|
| VOLTS/DIV | 1/10 to 10 times |
| TIME/DIV | 1 to 100 times |

**Caution**

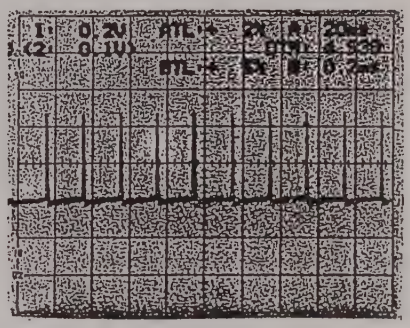
**Note on !SET UP! Display**

*If change of setting is performed over the above range, the sign !SETUP! is displayed on the upper left corner of the CRT. When this sign appears, the numerical values on the CRT can be changed according to the change in settings, but the waveform does not change.*

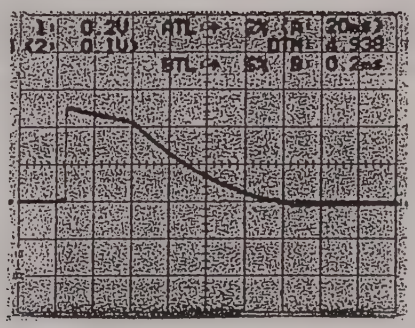
## B sweep Magnification

B sweep magnification is possible in storage mode.

1) A INTEN

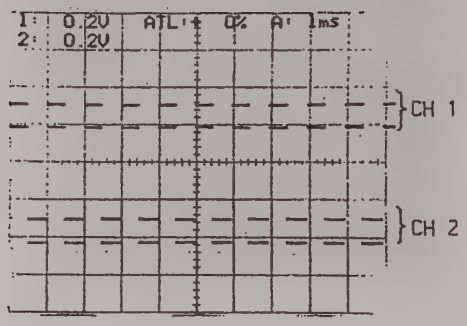


2) B (DLY'D)

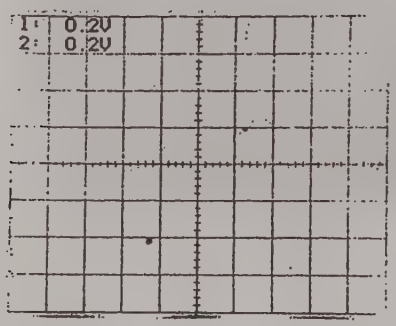


## 3-6 X-Y OPERATION

HORIZ DISPLAY At A

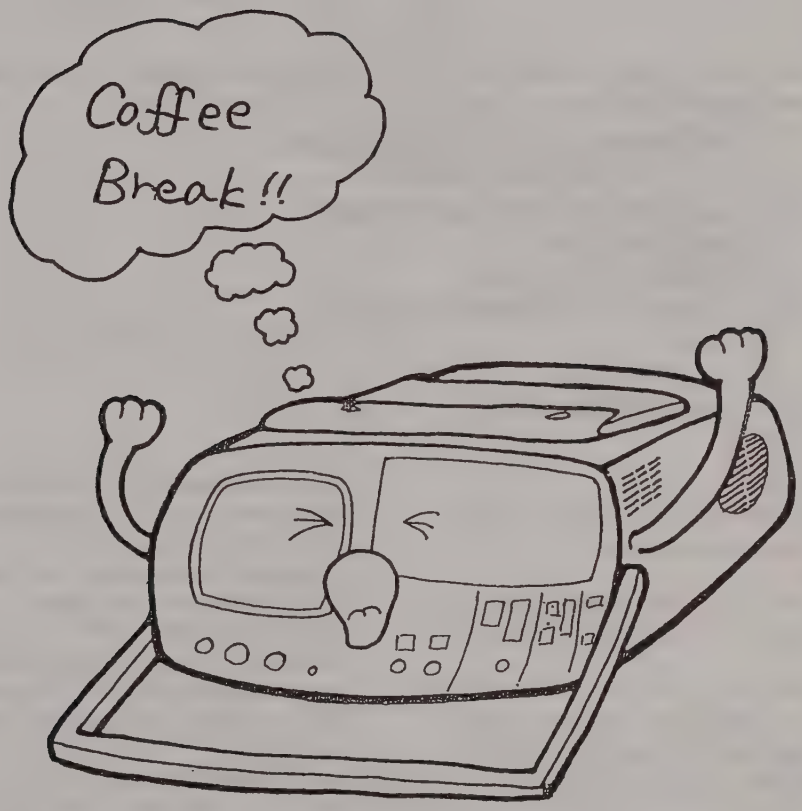



When HORIZ DISPLAY is set at X-Y, the following is displayed.




Operations when the STORAGE is set at ON are shown below.

| Vertical MODE | Operations |
|---|---|
| CH 1 | X axis: data of CH 1 currently captured<br>Y axis: data of CH 2 captured last |
| CH 2 | X axis: data of CH 1 captured last<br>Y axis: data of CH 2 currently captured |
| CH 1 & CH 2 | X axis: data of CH 1 currently captured<br>Y axis: data of CH 2 currently captured |


Coffee
Break!!

## 3-7 GUIDE MENU

GUIDE MENU and 1 2 3 4 5 6 7 8 9 0 Setting

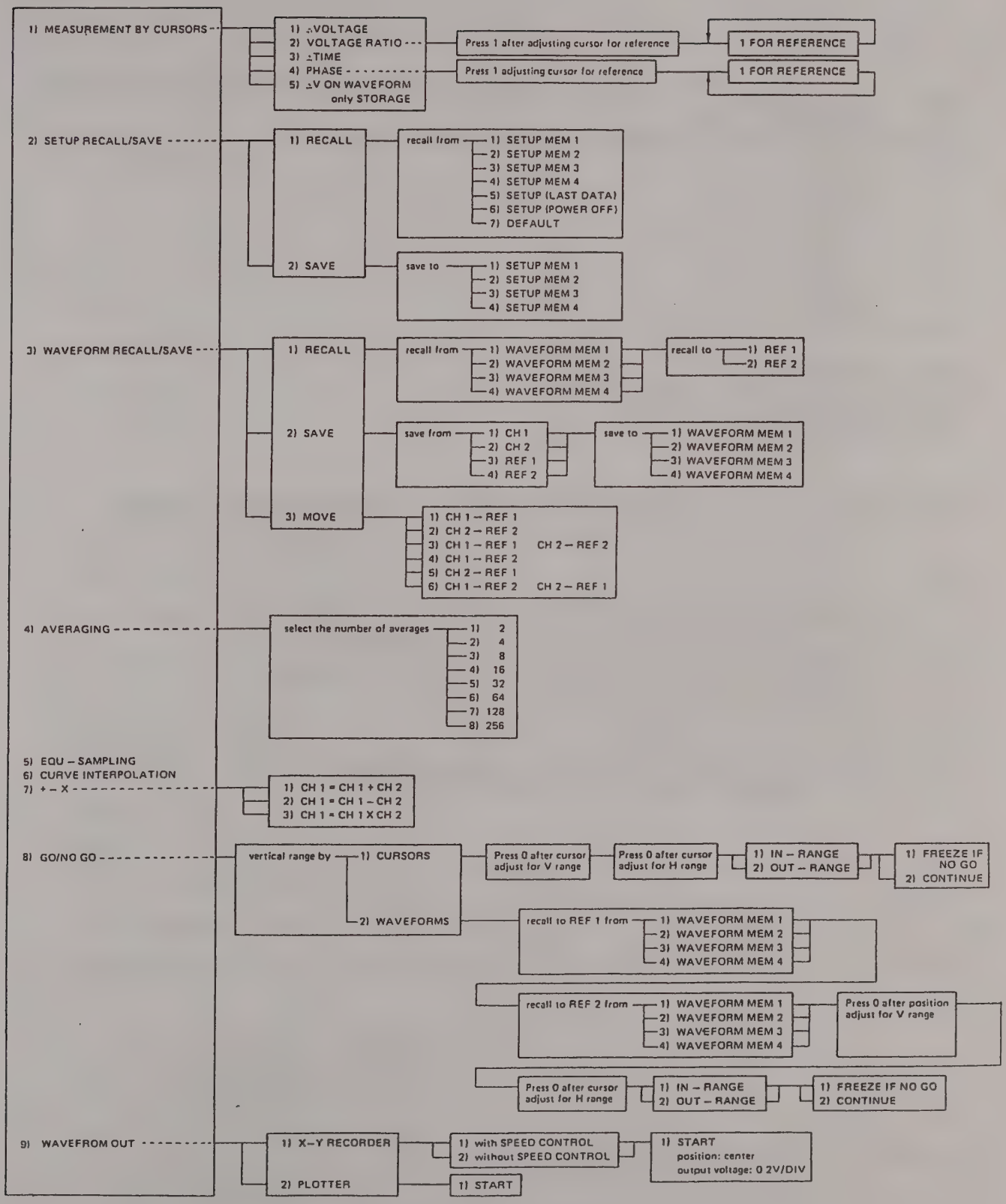
When GUIDE MENU is pressed, GUIDE MENU as shown in the following display appears on the screen. The number of FUCNTIONS to be used is selected from 1) to 9).

```
1) MEASUREMENT BY CURSORS
2) SETUP RECALL/SAVE
3) WAVEFORM RECALL/SAVE
4) AVERAGING
5) EQU-SAMPLING
6) CURVE INTERPOLATION
7) +-X
8) GO/NO GO
9) WAVEFORM OUT
```

1) Measurement by Cursors
   Cursor measurement can be performed in either the real-time or the storage mode.
2) Setup recall/save
   Used for saving and recalling setup (setting on the front panel). Up to four setups can be saved.
3) Waveform recall/save
   Used for saving or recalling waveform data. Up to four waveforms can be saved; these waveforms can be compared.
4) Averaging
   Eight setting levels are provided, enabling averaging from 2 up to 256 times.
5) Equivalent sampling
   Continuous waveforms of up to 100 MHz can be sampled in order and digitized.
6) Curve Interpolation
   This mode is for the interpolation of curves.
7) + - x Calculation
   Addition, subtraction or multiplication can be performed in this mode.
8) GO/NO GO Judgement
   Mainly used when judging whether a phenomenon is acceptable or not. The judgement range can be set by two methods, using cursors and waveforms.
9) Waveform Output
   The on-screen data can be output to an X-Y recorder or plotter. The speed of the waveform output to the X-Y recorder can be controlled, and its scale can be output.

And then select necessary key from 1) to 0) according to Guide Menu Free.

## Guide Menu Tree



## Usage Range

| *MENU NO.* | *STORAGE* | |
|---|---|---|
| | *OFF (REAL)* | *ON* |
| *1* | Δ*1 | ○ |
| *2* | ○ | ○ |
| *3* | *ERR 7* | ○ |
| *4* | *ERR 7* | ○ |
| *5* | *ERR 7* | Δ*2 |
| *6* | *ERR 7* | ○ |
| *7* | *ERR 7* | ○ |
| *8* | *ERR 7* | ○ |
| *9* | *ERR 7* | ○ |

**1 Except ΔV ON WAVEFORM*

**2 Effectuated when TIME/DIV is set at faster than 2 μs/DIV in the case of CH1, and faster than 5 μs/DIV in the case of CH2.*

## Error Messages

When non-allowable setting from GUIDE MENU was selected, an error message appears on the screen.

| Error Number | Description |
|---|---|
| ERR 1 | Non-selectable FUNCTION was selected while performing measurement by cursors |
| ERR 3 | Non-selectable FUNCTION was selected while performing EQU-SAMPLING |
| ERR 4 | Non-selectable FUNCTION was selected while performing CURVE INTERPOLATE |
| ERR 5 | Non-selectable FUNCTION was selected while performing + - X |
| ERR 7 | Non-selectable FUNCTION was selected which cannot be performed under present set up conditions |
| ERR 8 | Non-selectable FUNCTION was selected while performing AVERAGING |

## List of Functions Which can be Selected in Combination

The following table shows whether or not a particular F1 MENU item can be selected simultaneously with a particular F2 item.

| F1 \ F2 | 1) MEASUREMENT BY CURSORS | 2) SETUP RECALL/SAVE | 3) WAVEFORM RECALL/SAVE | 4) AVERAGING | 5) EQU-SAMPLING | 6) CURVE INTERPOLATION | 7) +−X | 8) GO/NO GO | 9) WAVEFROM OUT |
|---|---|---|---|---|---|---|---|---|---|
| 1) MEASUREMENT BY CURSORS | | O | O | O | O | O | O | | |
| 2) SETUP RECALL/SAVE | | | | | | | | | |
| 3) WAVEFORM RECALL/SAVE | | | | | | | | | |
| 4) AVERAGING | O | O | O | | O | O | O | O | O |
| 5) EQU-SAMPLING | O | O | O | O | | O | O | O | O |
| 6) CURVE INTERPOLATION | O | O | O | O | O | | O | O | O |
| 7) +−X | O | O | O | O | O | | | O | O |
| 8) GO/NO GO | | O | *1 | O | O | O | | | |
| 9) WAVEFORM OUT | | | | | | | | | |

O shows that the simultaneous selection is possible.

*1 SAVE can be performed simultaneously but RECALL should be performed with other modes.

## Quit of Guide Menu

- [QUIT/LOCAL] key is used for clearing FUNCTION selected from GUIDE MENU.

  Selecting multiple FUNCTIONS from GUIDE MENU and pressing [QUIT/LOCAL] after completion of operating, all FUNCTIONS is cleared.

  Selecting multiple FUNCTIONS from GUIDE MENU and pressing [QUIT/LOCAL] during operating, only one FUNCTION selected last is cleared.

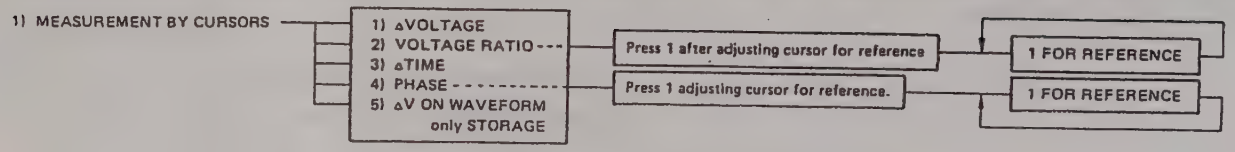
- Clearing a particular FUNCTION find its (OFF) display in GUIDE MENU and press the relevant numerical key with the corresponding function number.

```
1) MEASUREMENT BY CURSORS
2) SETUP RECALL/SAVE
3) WAVEFORM RECALL/SAVE
4) AVERAGING
5) EQU-SAMPLING
6) CURVE INTERPOLATION(OFF)
7) +-X
8) GO/NO GO
9) WAVEFORM OUT
```

When [7] is pressed, only 7) curve interpolation is cleared.

## 3-7-1 MEASUREMENT BY CURSORS

### MENU




Using two cursors, Δvoltage, voltage ratio, Δtime, phase and ΔV on waveform are measured.

Adjust the cursor position for measurement with CURSOR 1 and CURSOR 2.

When cursors are moving, the sign "WORKING" appears at the bottom of the CRT. Upon completion of cursor setting, "WORKING" sign disappears and the value measured as the separation between the two cursors appears at the lower right corner of the CRT.

**The Difference between ΔVOLTAGE and ΔV ON WAVEFORM**

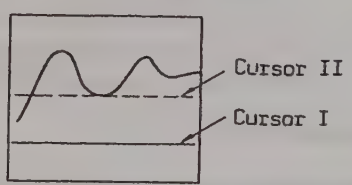
① Functional Difference

ΔVOLTAGE: Irrelevant to the waveforms, potential difference between the two cursors is calculated and shown on the CRT screen.

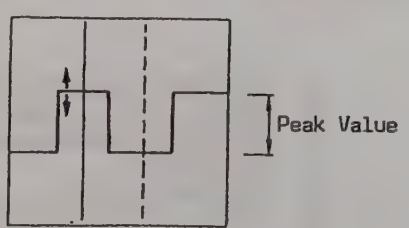
ΔV ON WAVEFORM: Potential difference is calculated on the basis of captured waveform data and shown on the CRT screen.

② Difference Upon Use

ΔVOLTAGE: Absolute voltage value can be measured if one of the cursors is fixed at the GND line upon measurement.




ΔV ON WAVEFORM: In the case as shown in the following figure, the peak value can be measured without moving the cursors even when the waveform amplitude fluctuates.



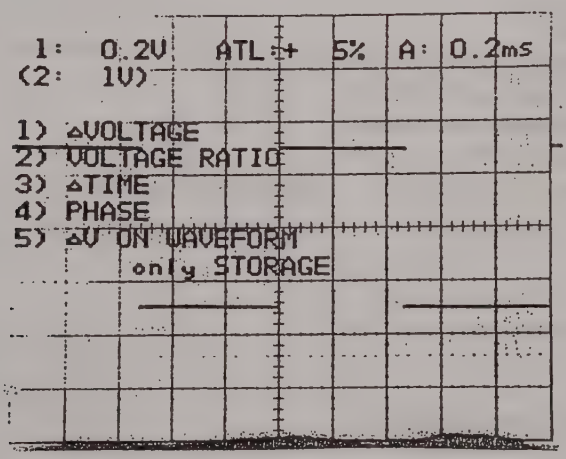
Described below is the example of measurement with CAL input and the following settings.

| | |
|---|---|
| V. MODE | CH 1 |
| VOLTS/DIV | 0.2 V |
| A TIME/DIV | 0.2 ms |

Press [1] while GUIDE MENU is displayed, and displays a figure as shown in Figure 3-7-1.

Next, press the numerical key [1] to [5] to select FUNCTION for the measurement.

Figure 3-7-1. Example of Measurement by Cursors



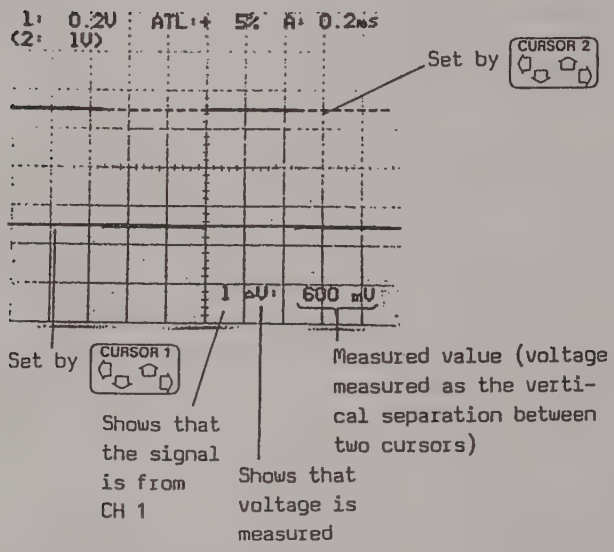
## 3-7-1-1 ΔVOLTAGE

Measures potential difference between two cursors. When the cursor 2 is upper and the cursor 1 lower, indicates "+". When the Y axis deflection factor is uncal, indicates a unequal mark ">" or "<".

**Procedure**

① Press [1] while Figure 3-7-1 is displayed.

② Adjust the cursors positions for measurement with two cursors. Measured results are displayed at the lower right corner on the CRT.


1: 0.2V ATL: + 5% A: 0.2ms
(2: 1V)
Set by CURSOR 2
1 ΔV: 600 mV
Set by CURSOR 1
Shows that the signal is from CH 1
Shows that voltage is measured
Measured value (voltage measured as the vertical separation between two cursors)

**Unit and Unequal mark**

Refer to table below.

| STORAGE | Measuring Item | Unit | Measuring Result | |
|---|---|---|---|---|
| | | | + | - |
| OFF (REAL) | Except ADD | V | > | < |
| | ADD | div | | |
| ON | Except +-x | V | > | < |
| | +-x | div | | |

**Caution**

*The sign is positive when the Cursor 1 is in the lower half of the screen.*
*The sign ">" is displayed when Y axis sensitivity is set at UNCAL.*

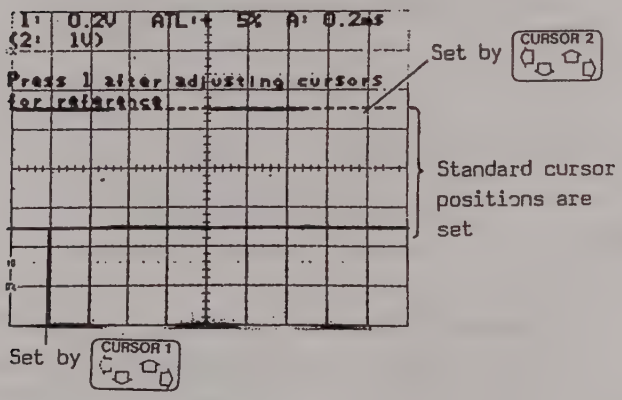
## 3-7-1-2 VOLTAGE RATIO

The potential difference between the standard cursor positions set prior to the measurement is defined as 0 dB and 100%. The ratio of the voltage calculated against this standard difference for CH 1 or CH 2 measured by the two cursors is to be displayed both in percent (%) and in decibels (dB).

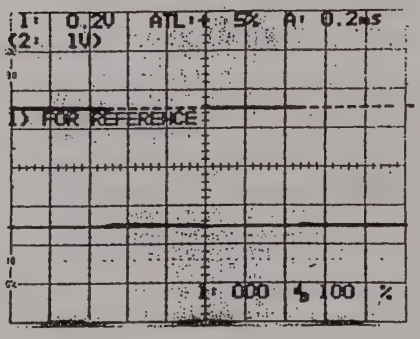
**Procedure**

① Press [2] while Figure 3-7-1 is displayed.

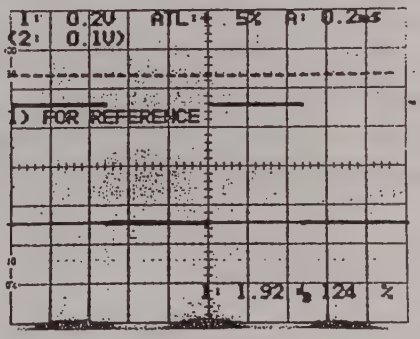
② Adjust the cursor position for measurement with two cursors.




③ Press [1] , and the following is displayed (the value between two cursors are now set as 0.00 dB and 100%).



④ For example, when the position of CURSOR 2 is set as in the figure below with ⬡ of [CURSOR 2] key, it is compared with the standard potential difference set in operation ③ above and 1.92 dB and 124% are indicated on the screen.



⑤ Press [4] again, and the values between two cursors are reset as 0.00 dB and 100%.

**Unequal Mark**

Refer to table below.

| STORAGE | Measuring Item | Measuring Result | | | |
|---|---|---|---|---|---|
| | | + | | − | |
| | | UNCAL → CAL | CAL→ UNCAL | UNCAL → CAL | CAL→ UNCAL |
| OFF (REAL) | Except ADD | > | < | < | > |
| | ADD | | | | |
| ON | Except +−x | > | < | < | > |
| | +−x | | | | |

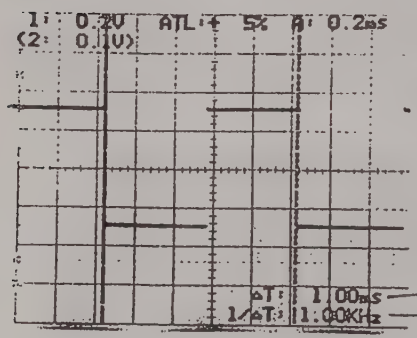
### 3-7-1-3 ΔTIME

The time difference two cursors and its reciprocal (frequency) are displayed in units of "s" and "Hz". Indicates "+" when the CURSOR 1 is on the left half of the screen.

**Procedure**

① Press [3] while Figure 3-7-1 is displayed.

② Adjust the cursor positions. Measured results are displayed at the lower right conner on the CRT.




Indicates TIME

Indicates FREQUENCY

**Unequal Mark**

Refer to table below.

| Display | STORAGE | Measuring Result | |
|---|---|---|---|
| | | + | - |
| Time display | OFF (REAL) | > | < |
| | ON | | |
| Frequency display | OFF (REAL) | < | |
| | ON | | |

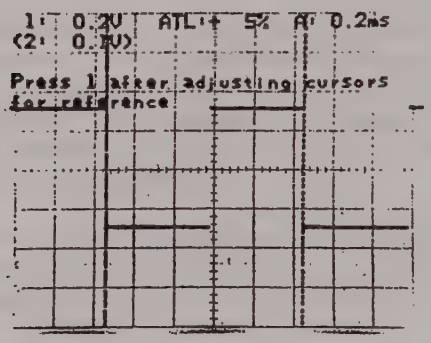
## 3-7-1-4 PHASE

One cycle of waveform is defined as 360 degrees and the phase measured by two cursors is displayed in unit of "degree". Indicates "+" when CURSOR 1 is on the left half of the screen.

**Procedure**

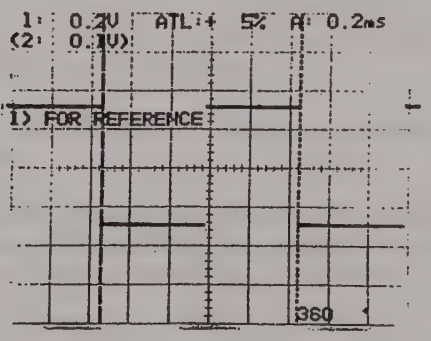
① Press [4] while Figure 3-7-1 is displayed.

② Adjust two cursors to bracket one cycle of waveform.

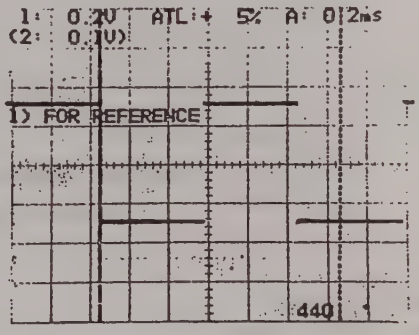



③ Press [1] , and the following is displayed.

The phase between the two cursors are now defined as 360 degree.




④ When the position of the CURSOR 2 is set as shown in the figure below by ⌂▯ of [CURSOR 2 ⌂▯ ⌂▯] key, the measured phase difference between the two cursors is indicated as 440 degree at the lower right corner of the CRT.




⑤ Press [1] again, and the value between two cursors in reset as 360 degree.

**Unequal Mark**

Refer to table below.

| STORAGE | Measuring Result | | | |
|---|---|---|---|---|
| | + | | − | |
| | UNCAL → CAL | CAL → UNCAL | UNCAL → CAL | CAL → UNCAL |
| OFF (REAL) | < | > | < | > |
| ON | | | | |

## 3-7-1-5 ΔV ON WAVEFORM

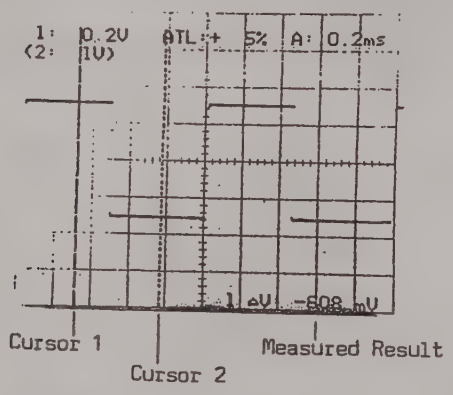
Measures potential difference between two waveform with two cursors.

**Procedure**

① Set [STORAGE] to ON.

② Press [5] while Figure 3-7-1 is displayed.

③ Adjust the cursor position for measurement with two cursors. Measured results are displayed at the low right corner on the CRT.




**Caution**

- *Effective even in arithmetic (+ - X) mode.*
- *x10 MAG mode is not allowed.*
- *Horizontal position is fixed at the center.*

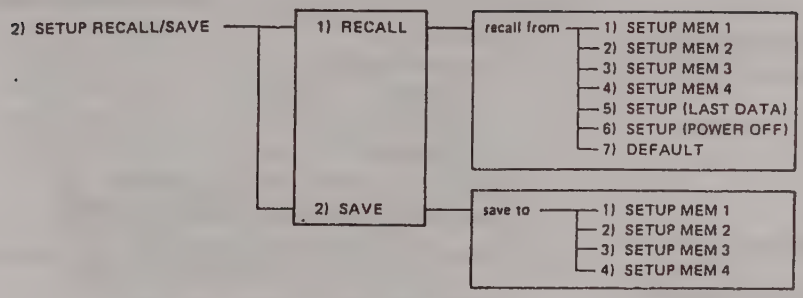
**Unit and Unequal Mark**

Refer to table below.

| STORAGE | Measuring Item | Unit | Measuring Result | |
|---|---|---|---|---|
| | | | + | - |
| OFF (REAL) | | | | |
| ON | Except +-x | V | > | < |
| | +-x | div | | |

## 3-7-2 SETUP RECALL/SAVE

### MENU




Settings made on the front panel can be saved in Memory 1 to 4 and recalled when necessary for confirmation. When LAST DATA, POWER OFF, or DEFAULT is selected, the relevant settings are automatically saved in memory, and can be recalled when necessary.

SETUP (LAST DATA): Settings made upon the last data entry while the power is on can be recalled even after the power is switched off.

SETUP (POWER OFF): Settings changed after the last data entry, for waveform magnification, etc., can be recalled even after the power is switched off.

SETUP (DEFAULT): Used for returning to the initial settings because of mistakes in setting, etc. Whenever the power is turned on, this DEFAULT setting is made.

The power for the memory is backed up by a battery.

Described below is example of operations concerning SAVE and RECALL of memory 1) to 4), RECALL of LAST DATA, POWER OFF, and DEFAULT under CAL input.

## 3-7-2-1 SAVE

**Procedure I (Save to memory 1)**

"SET UP State" Setting

① Display the waveform to be saved on the CRT.
Setting example:

| | |
|---|---|
| V. MODE | ALT |
| VOLTS/DIV | 1 V |
| A TIME/DIV | 5 ms |

"SET UP RECALL/SAVE" Setting

② Press [2] while GUIDE MENU is displayed, and the following is displayed.

```
1) RECALL
2) SAVE
```

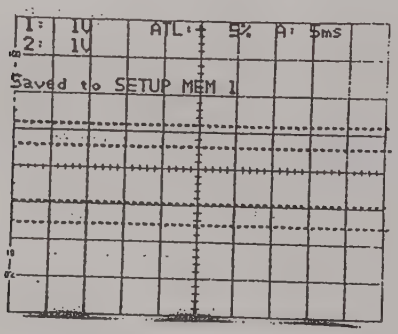
"SAVE" Setting

③ Press [2] again, and the following is displayed.

```
save to
1) SETUP MEM 1
2) SETUP MEM 2
3) SETUP MEM 3
4) SETUP MEM 4
```

"SAVE to" Selecting

④ Press [1], and the following is displayed, and this waveform is saved in Memory 1.




**Procedure II (Save to memory 2)**

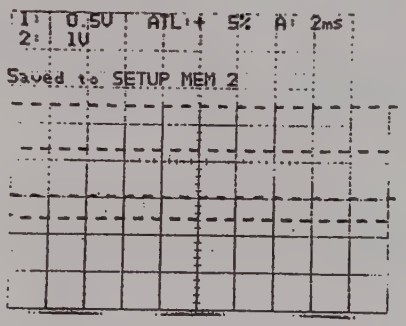
①' Display the waveform to be saved next on the CRT.
Setting example:

| | |
|---|---|
| V. MODE | ALT |
| VOLTS/DIV | 1 V |
| A TIME/DIV | 1 ms |

②' Operate as described in operation ②.

③' Operate as described in operation ③.

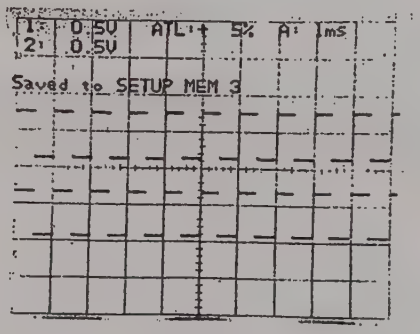
④' Press [2], and the following is displayed (this waveform is saved in Memory 2).




**Procedure III (Save to memory 3)**

Similarly, save the waveform with the following in Memory 3.
Setting example:

| | |
|---|---|
| V. MODE | ALT |
| VOLTS/DIV | 0.5 V |
| A TIME/DIV | 1 ms |

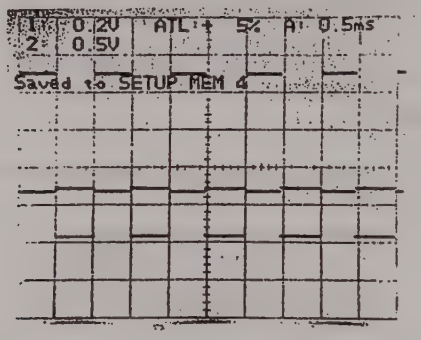


**Procedure IV (Save to memory 4)**

Similarly, save the waveform with the following setting in Memory 4.

Setting example:

| | |
|---|---|
| V. MODE | ALT |
| CH 1 VOLTS/DIV | 0.2 V |
| CH 2 VOLTS/DIV | 0.5 V |
| A TIME/DIV | 0.5 ms |



## 3-7-2-2 RECALL

**Procedure**

"SETUP RECALL/SAVE" Setting

① Press [2] while GUIDE MENU is displayed, and the following is displayed.

```
1) RECALL
2) SAVE
```

"RECALL" Setting

② Press [1], and the following is displayed.

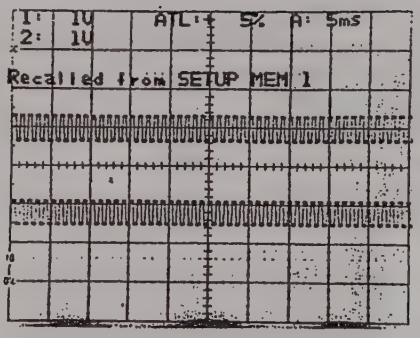
```
recall from
1) SETUP MEM 1
2) SETUP MEM 2
3) SETUP MEM 3
4) SETUP MEM 4
5) SETUP(LAST DATA)
6) SETUP(POWER OFF)
7) DEFAULT
```

"Recall from" Setting

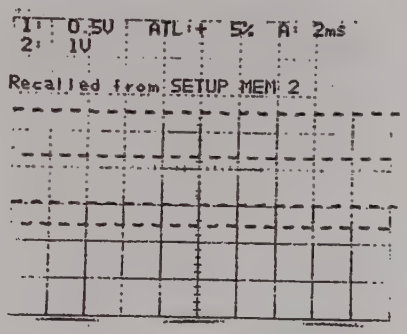
③ Press the numerical key corresponding the number of data to be recalled.

Described below is each of the recalled waveform.

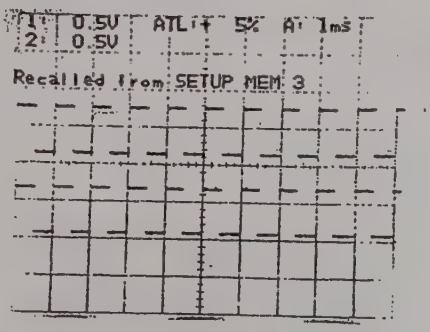
1) SETUP MEM 1



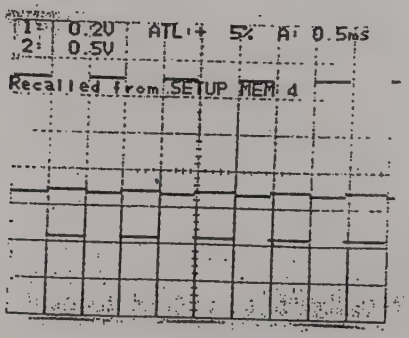

2) SETUP MEM 2



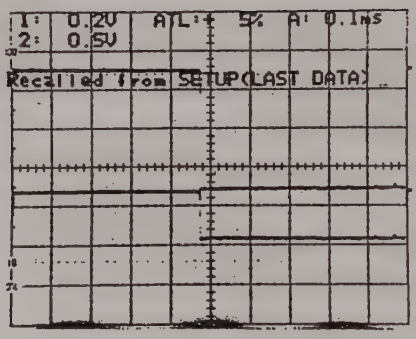

3) SETUP MEM 3



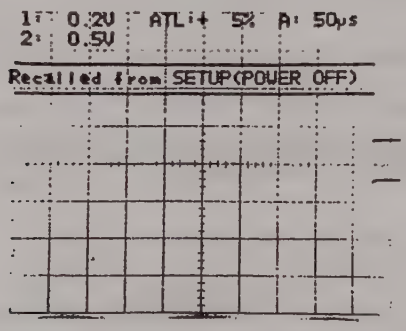

4) SETUP MEM 4



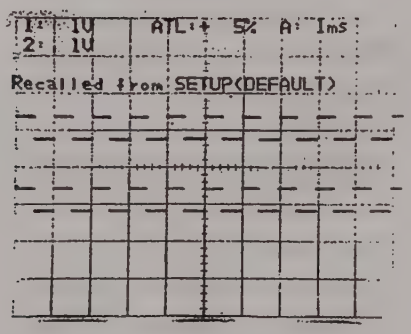
5) SETUP (LAST DATA)




6) SETUP (POWER OFF)

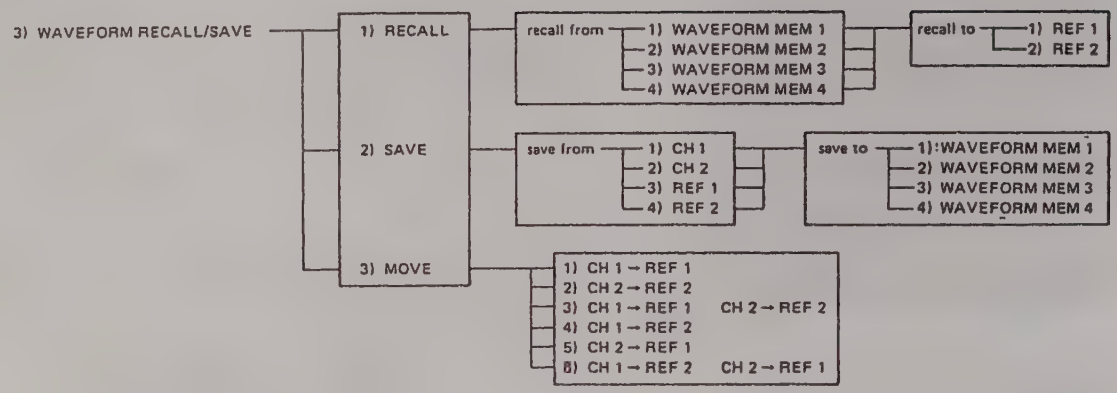



7) DEFAULT



## 3-7-3 WAVEFORM RECALL/SAVE

MENU


3) WAVEFORM RECALL/SAVE
1) RECALL
recall from
1) WAVEFORM MEM 1
2) WAVEFORM MEM 2
3) WAVEFORM MEM 3
4) WAVEFORM MEM 4
recall to
1) REF 1
2) REF 2
2) SAVE
save from
1) CH 1
2) CH 2
3) REF 1
4) REF 2
save to
1):WAVEFORM MEM 1
2) WAVEFORM MEM 2
3) WAVEFORM MEM 3
4) WAVEFORM MEM 4
3) MOVE
1) CH 1 → REF 1
2) CH 2 → REF 2
3) CH 1 → REF 1 CH 2 → REF 2
4) CH 1 → REF 2
5) CH 2 → REF 1
6) CH 1 → REF 2 CH 2 → REF 1

Used for saving in memory the waveforms which are to be stored, the standard one, or to be used for later comparison.

The power for the memory is backed up by a battery.

Described below is a measurement example which under CAL input, a signal from CH 1 is saved in memory 1 and a signal from CH 2 in memory 2, and recalled to REF 1 and REF 2 respectively.

### 3-7-3-1 SAVE

**Procedure I (CH 1 signal to memory 1)**

——— "STORAGE" and "V. MODE" Setting ———

① Set [STORAGE] to ON.

② Set V. [MODE] to CH 1 CH 2 & REF.

——— "SETUP State" Setting ———

③ Display the waveform to be saved on the CRT.
Setting example:

| | |
|---|---|
| V. MODE | CH 1 |
| VOLTS/DIV | 1 V |
| A TIME/DIV | 1 ms |

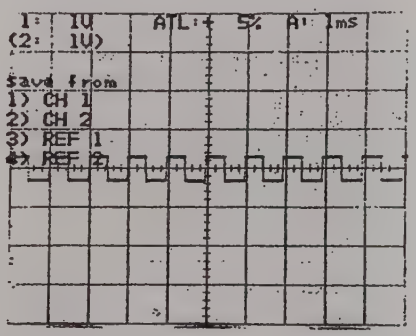
——— "WAVEFORM RECALL/SAVE" Setting ———

④ Press [3] while GUIDE MENU is displayed, and the following is displayed.

1) RECALL
2) SAVE
3) MOVE

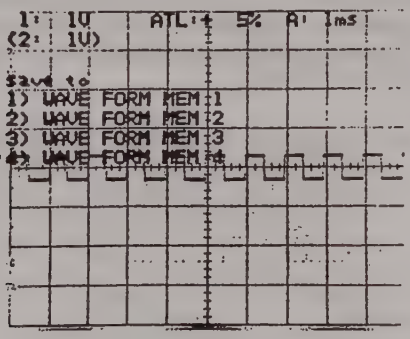
——— "SAVE" Setting ———

⑤ Press [2] (SAVE is selected), and the following is displayed.



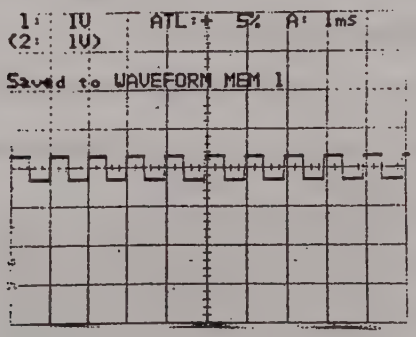
"Save from" Setting

⑥ Press [1] (CH 1 is selected), and the following is displayed.




"Save to" Setting

⑦ Press [1] (WAVEFORM MEM 1 is selected), and the following is displayed (this waveform is saved in the Memory 1).




**Procedure II (CH2 signal to memory 2)**

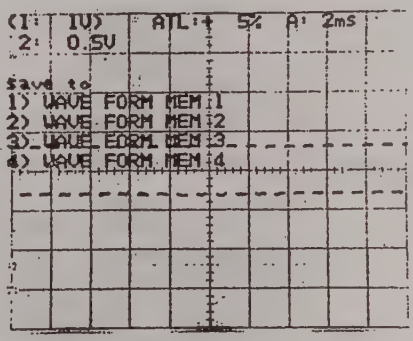
③' Display the waveform to be saved next on the CRT.
Setting example:

| | |
|---|---|
| V. MODE | CH 2 |
| VOLTS/DIV | 0.5 V |
| A TIME/DIV | 2 ms |

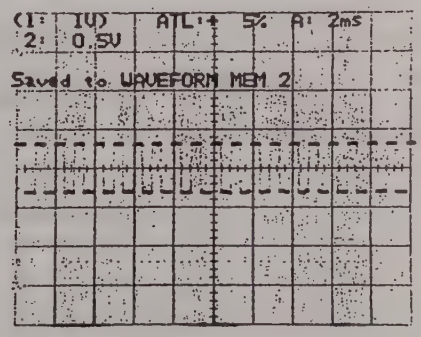
④' Repeat operation ④ above.

⑤' Repeat operation ⑤ above.

⑥' Press [2] (CH 2 is selected), and the following is displayed.




⑦' Press [2] (CH 2 is selected), and the following is displayed (this waveform is saved in the Memory 2).




Other waveforms can be saved in this way.

## 3-7-3-2 RECALL

**Procedure I (Memory 1 to REF 1)**

———— "STORAGE" and "V. MODE" Setting ————

① Set [STORAGE] to ON.

② Set V. [MODE] to CH 1 CH 2 & REF.

———— "WAVEFORM RECALL/SAVE" Setting ————

③ Press [3] while GUIDE MENU is displayed, and the following is displayed.

```
1) RECALL
2) SAVE
3) MOVE
```

———— "RECALL" Setting ————

④ Press [1], and the following is displayed.

```
recall from
1) WAVE FORM MEM 1
2) WAVE FORM MEM 2
3) WAVE FORM MEM 3
4) WAVE FORM MEM 4
```

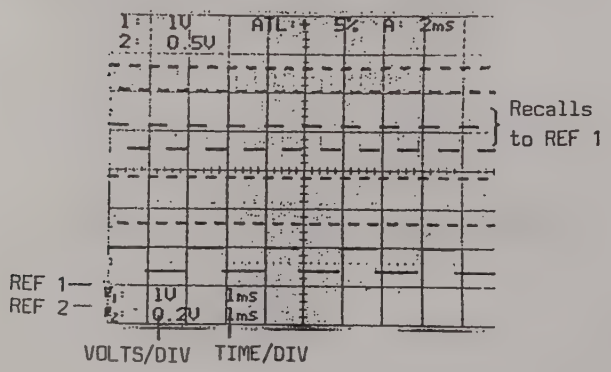
———— "recall from" Setting ————

⑤ Press [1] again, and the following is displayed.

```
recall to
1) REF 1
2) REF 2
```

———— "recall to" Setting ————

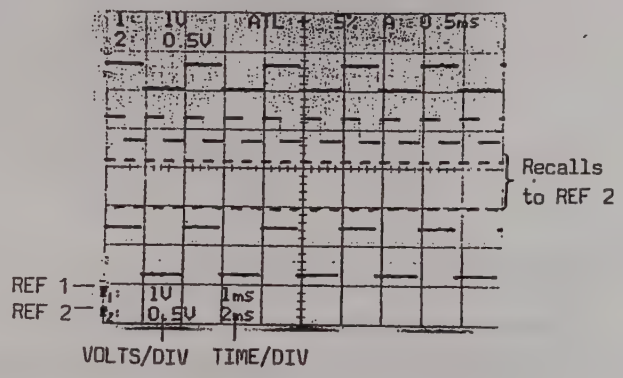
⑥ Press [1] again, and the following figure is displayed, recalling the waveform saved by operations ③ to ⑧ described in the section 3-7-3-1 SAVE.




**Procedure II (Memory 2 to REF 2)**

Operate as described in operations ③ to ⑤.

⑥' Press [2], and the following figure is displayed, recalling the waveform saved by operations ③ to ⑦ described in the section 3-7-3-1 SAVE.



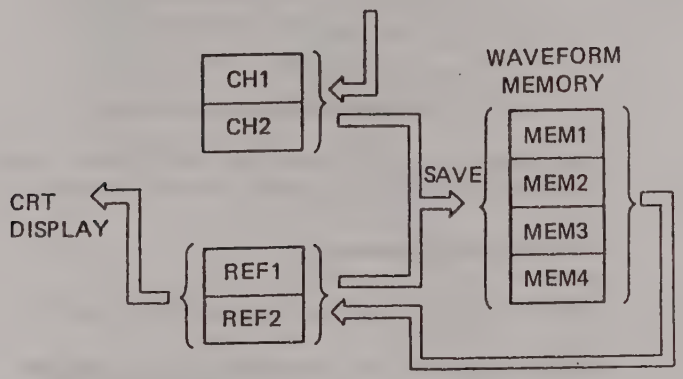

**REF 1 and REF 2 Adjustment**

Setting [2nd FUNC] to ON, vert position and deflection factor of REF 1 and REF 2 can be adjusted with [POSITION] and [VOLTS/DIV].

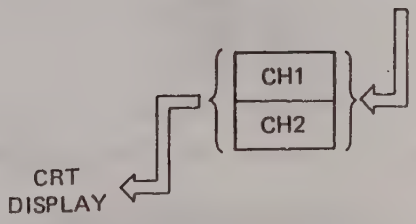
### Observation of Four Phenomena by Using WAVEFORM MEMORY

Set STORAGE to ON and V. MODE set to REF, and simultaneous observation of two saved waveforms and two unsaved waveforms are possible. Respective flowcharts are shown below.

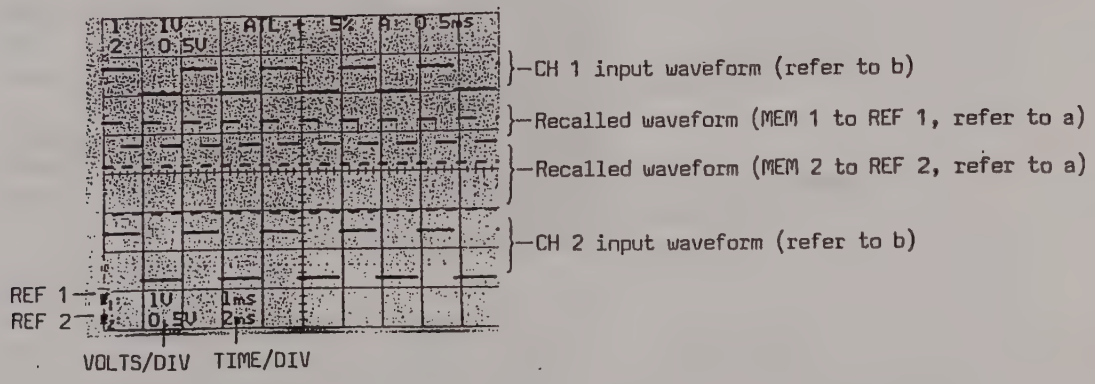
a. Display the recalled waveforms to REF 1 and REF 2




b. Display the waveforms of CH 1 and CH 2 without saving them




### Measurement Example


1 1V AC 5% A 0.5ms
2 0.5V
CH 1 input waveform (refer to b)
Recalled waveform (MEM 1 to REF 1, refer to a)
Recalled waveform (MEM 2 to REF 2, refer to a)
CH 2 input waveform (refer to b)
REF 1
REF 2
1V 1ms
0.5V 2ms
VOLTS/DIV
TIME/DIV

## 3-7-3-3 MOVE

**Procedure (CH1 → REF 1, CH1 → REF 2)**

① Set [STORAGE] to ON.

② Set V. [MODE] to CH 1 CH 2 & REF.

"WAVEFORM RECALL/SAVE" Setting

③ Press [3] while GUIDE MENU is displayed, while and the following is displayed.

1) RECALL
2) SAVE
3) MOVE

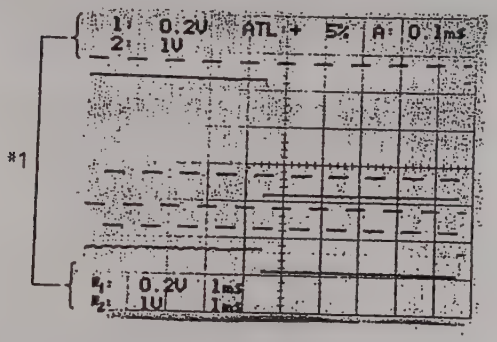
"MOVE" Setting

④ Press [3], and the following is displayed.

1) CH1→REF1
2) CH2→REF2
3) CH1→REF1 CH2→REF2
4) CH1→REF2
5) CH2→REF1
6) CH1→REF2 CH2→REF1

"MOVE content" Selecting

⑤ Press [3] (select CH 1 → REF 1, CH 2 → REF 2), and the following is displayed.




Indicates that the waveforms are moved from CH 1 display to REF 1 display and CH 2 to REF 2.

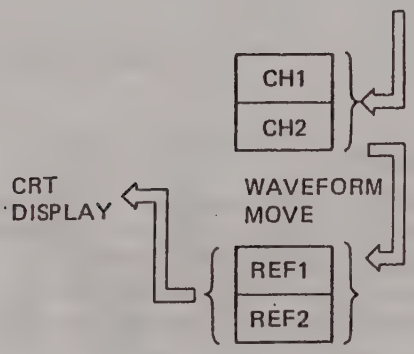
**REF 1 and REF 2 Adjustment**

Setting [2nd FUNC] to ON, vert position and deflection factor of REF 1 and REF 2 can be adjusted with [POSITION] and [VOLTS/DIV].

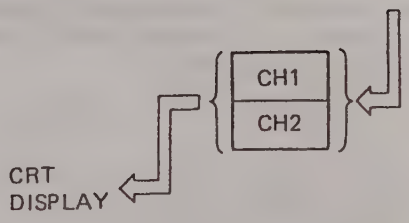
**Observation of Four Phenomena without Using WAVE-FORM MEMORY**

When [STORAGE] is set at ON and V. [MODE] set at REF, simultaneous observation of two moved waveforms and the unmoved waveforms is possible.

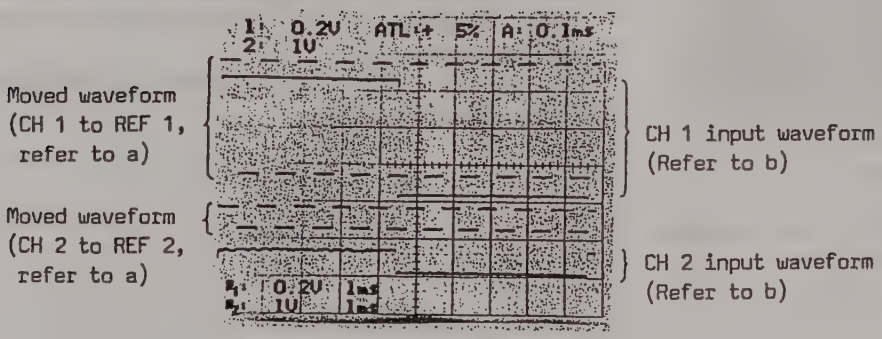
a. Display the moved waveforms to REF 1 and REF 2




b. Display the unmoved waveforms to CH 1 and CH 2

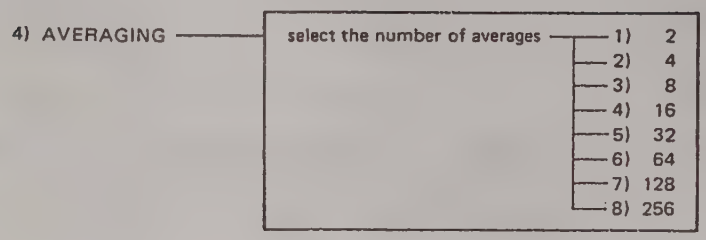



**Measurement Example**



## 3-7-4 AVERAGING

### MENU

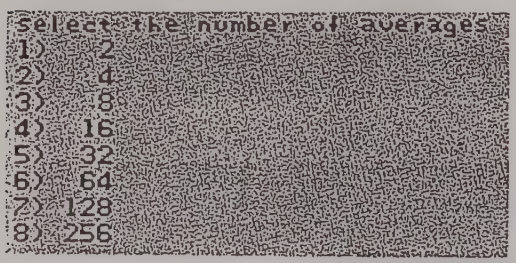



Used for extracting signals with regularity observed in noises. (A trigger signal triggered with that signal is neccessary.)

#### Procedure

① Set [STORAGE] to ON.

② Press [4] while GUIDE MENU is displayed, and the following is displayed.




③ Press [8] (256 is selected).

④ Press [FREEZE] (select OFF), and averaging is started.

#### Reference

Press [FREEZE] if averaging is to be interrupted. On the CRT, the waveform averaged at $2^n$th measurements immediately before interruption. Press [FREEZE] again, and averaging is resumed.

#### Averaging Methode

The rate of noise component elimination is proportional to the square root of N, the number of measurements used for the AVERAGING.

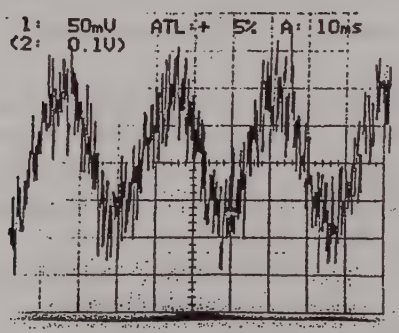
For example, when AVERAGING is performed after 32 measurements, noise is reduced to 1/5.6 (15 dB).

Averaging is done at every $2^n$ measurements.

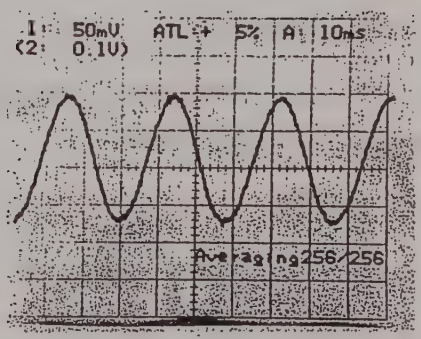
For example, if n is set at 5, data is rewritten at every 2, 4, 8, 16 and 32 measurements. When measurement by cursors is done at the same time, rewriting of the cursor is done at every $2^n$ measurement.

Described below is a measurement example when under sine wave input.

1) Before Averaging




2) After Averaging



## 3-7-5 EQU-SAMPLING

Used when rapid repetitive signals are to be observed. Of two methods for equivalent sampling, random sampling and sequential sampling, the latter is employed in the DS-6121.

In the case of repeated wavefrorms, those with frequency up to 100 MHz can be stored. This is effective at rate faster than 2 ns/DIV in the case of CH 1, and faster than 5 ns/DIV in the case of CH 2.

Described below is a measurement example

**Caution**

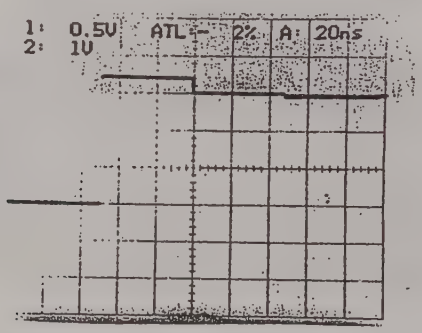
*A normal waveform is not displayed unless trigger is appropriately applied.*
*When using this FUNCTION at high sensitivity (1 – 5 mV/DIV), special attention should be paid. When the trigger cannot be applied appropriately, set TRIGGER COUPLING at HF REF.*

**Procedure**

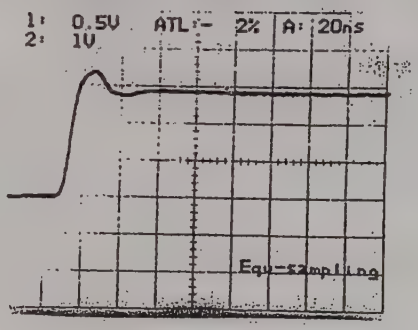
① Set [STORAGE] to ON.

② Press [5] while GUIDE MENU is displayed, and Equ-sampling is performed.

1) Before Equ-sampling




2) After Equ-sampling



## 3-7-6 CURVE INTERPOLATION

Used to enhance the frequency characteristics further when the data quantity is reduced because the sweep time is in a rapid range, or the waveform was magnified.

This is effective only when the number of effective data on the CRT is 1/10.

Described below is a measurement example.

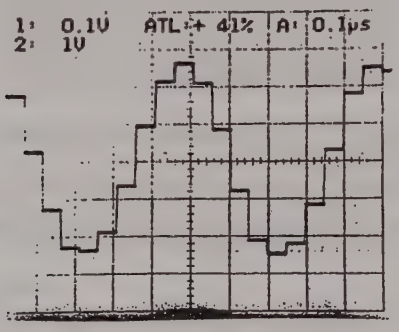
**Procedure**

① Set [STORAGE] to ON.

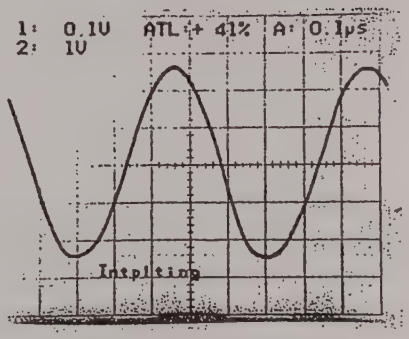
② Press [6] while GUIDE MENU is displayed, curve interpolation is performed.

When "WORKING" is displayed, it is in operation, and after interpolation is completed, "INTPLTING" is displayed. This is repeated. If interim observation is desired, press [FREEZE] key.

1) Before Curve Interpolation

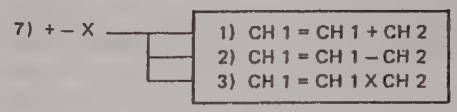



2) After Curve Interpolation



## 3-7-7 + − X

MENU




Displays a result of calculation between CH 1 input and CH 2 input in CH 1 display.

The following three calculations can be done.

CH 1 (Display) = CH 1 (Input) + CH 2 (Input)
CH 1 (Display) = CH 1 (Input) - CH 2 (Input)
CH 1 (Display) = CH 1 (Input) × CH 2 (Input)

In multiplicating, the center on the CRT is defined as zero, and

(+1 DIV) × (+1 DIV) = +1 DIV
(+1 DIV) × (-1 DIV) = -1 DIV

Particularly, the multiplication mode is useful, for example, when an instantaneous power waveform is to be observed.

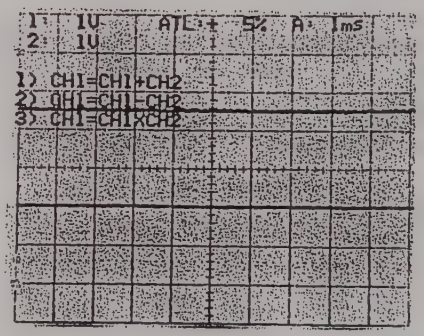
Example of calculation when CH 1 input is set at about 1.5 DIV above from the center, CH 2 input at about 1 DIV below (V COUPL is set to DC for both CH 1 and CH 2).

**Procedure**

① Set [STORAGE] to ON.

② Press [7] while GUIDE MENU is displayed, and the following is displayed.

CH 1 about +1.5 DIV
CH 2 about -1.0 DIV

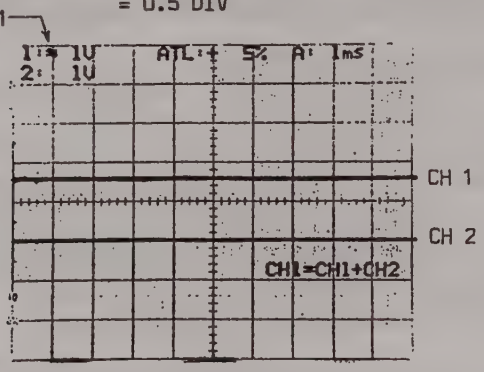



③ Press [1], and addition is performed.
Press [2], and subtraction is performed.
Press [3], and multiplication is performed.

**Addition**

Press [1] , the following is displayed.

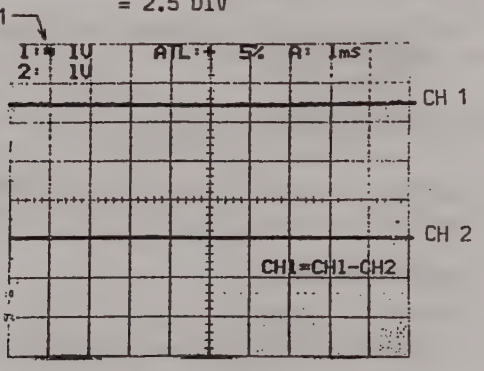
CH 1 (Display) = CH 1 (+1.5) + CH 2 (-1)
= 0.5 DIV




**Subtraction**

Press [2] , the following is displayed.

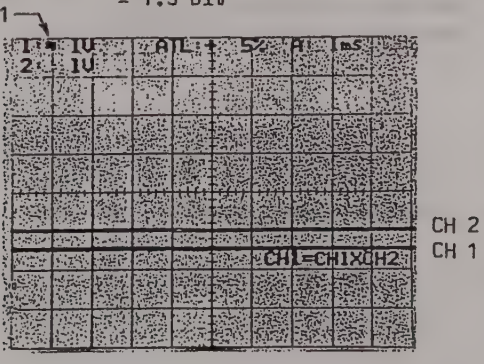
CH 1 (Display) = CH 1 (+1.5) - CH 2 (-1)
= 2.5 DIV




**Multiplication**

Press [3] , the following is displayed.

CH 1 (Display) = CH 1 (+1.5) × CH 2 (-1)
= 1.5 DIV

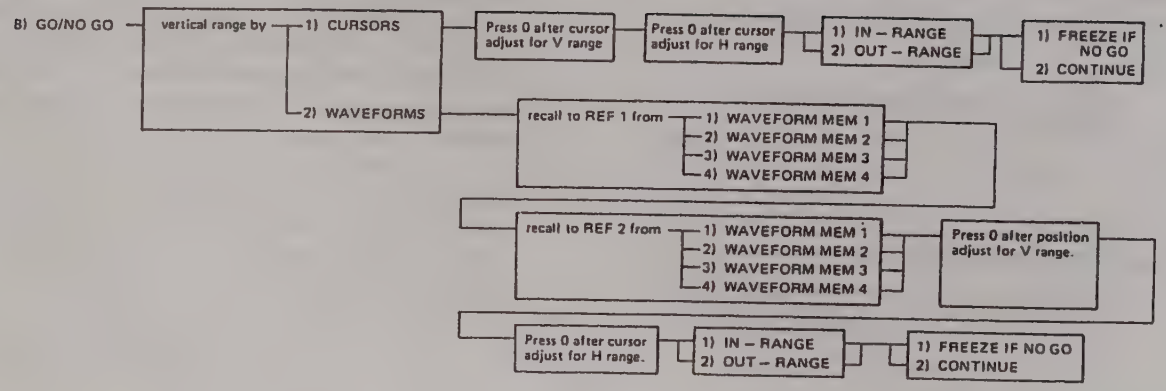



**≒ Display (*1)**

This shows that the calculation is conducted by the data displayed on the CRT (in divisions) irrelevant of the deflection factor. Therefore, CH 1 deflection factor display is ineffective and an unequality " " is displayed. Results of calculation are displayed on CH 1.

## 3-7-8 GO/NO GO

### MENU


8) GO/NO GO
vertical range by
1) CURSORS
2) WAVEFORMS
Press 0 after cursor adjust for V range
Press 0 after cursor adjust for H range
1) IN – RANGE
2) OUT – RANGE
1) FREEZE IF NO GO
2) CONTINUE
recall to REF 1 from
1) WAVEFORM MEM 1
2) WAVEFORM MEM 2
3) WAVEFORM MEM 3
4) WAVEFORM MEM 4
recall to REF 2 from
1) WAVEFORM MEM 1
2) WAVEFORM MEM 2
3) WAVEFORM MEM 3
4) WAVEFORM MEM 4
Press 0 after position adjust for V range.
Press 0 after cursor adjust for H range.
1) IN – RANGE
2) OUT – RANGE
1) FREEZE IF NO GO
2) CONTINUE

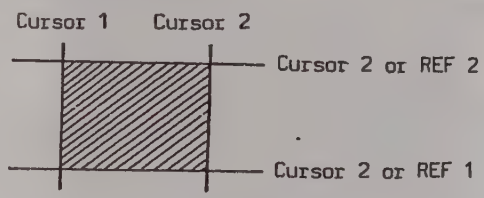
The judgement is done by pressing IN RANGE or OUT RANGE. There are two judging method as listed in the following.

a) **CURSORS**
Both vertical and horizontal axes are to be set by cursors.

b) **WAVEFORMS**
The vertical axis is set by two waveforms recalled from REF 1 and REF 2, and the horizontal axis by the cursor.

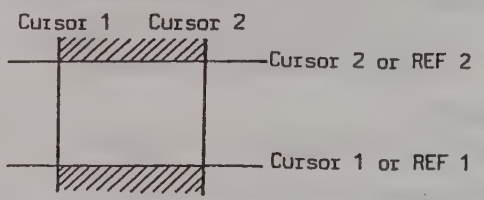
### Definitions of IN-RANGE and OUT-RANGE

- **IN-RANGE Setting**




Waveform is within oblique lines : IN-RANGE GO
Waveform is without oblique lines: IN-RANGE NO GO

- **OUT-RANGE Setting**



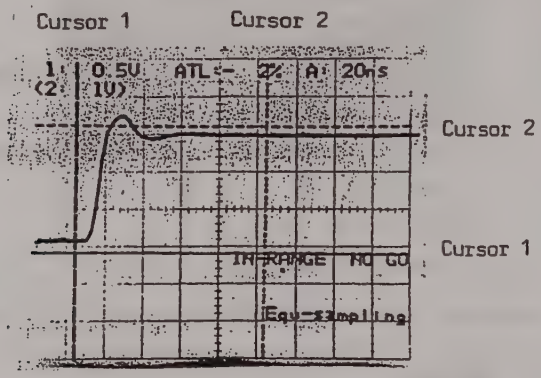

Waveform is within oblique lines : OUT-RANGE GO
Waveform is without oblique lines: OUT-RANGE NO GO

## Measurement Example

Used for determing whether the observed waveform is within the specified range or not.

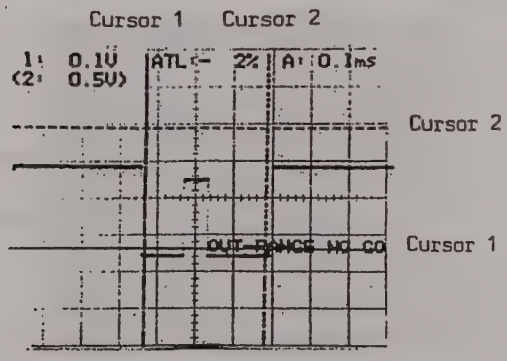
Useful in automatic control or automatic judgement.

### 1) Overshoot Judgement



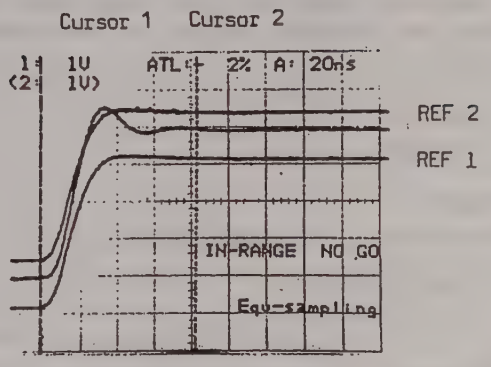

Assumed specifications: Overshoot < 3%
The vertical cursor 2 is adjusted to the position of 3% level.
The vertical cursors 1 and 2 can be positioned at left and right ends of the CRT.
IN-RANGE is to be selected.

### 2) Detection of Abnormal Signals




Assumed specifications: No glitches at the lower level part of the pulse waveform.
The transverse cursor 2 can be positioned at the upper end of the CRT.
OUT RANGE and FREEZE IF NO GO are to be selected.

### 3) Waveform Judgement




IN RANGE is to be selected.

## 3-7-8-1 CURSORS

Described below is the measurement example when the following setting is made under CAL input.

| | |
|---|---|
| V. MODE | CH 1 |
| VOLTS/DIV | 0.5 V |
| A TIME/DIV | 50 s |

**Procedure**

"STORAGE" Setting

① Set [STORAGE] to ON.

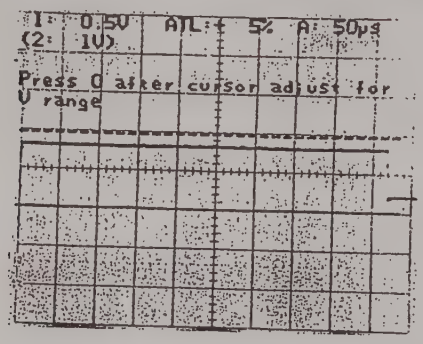
"GO/NO GO" Setting

② Press [8] while GUIDE MENU is displayed, and the following is displayed.

vertical range by
1) CURSORS
2) WAVEFORMS

"CURSORS" Setting

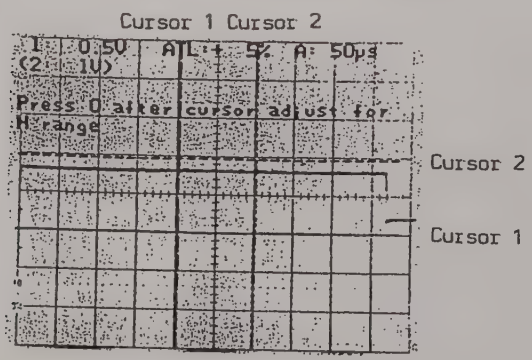
③ Press [1], and the following is displayed.




"V. Cursors" Adjustment

④ Adjust the vertical positions of the cursors with [CURSOR 1] and [CURSOR 2] keys.

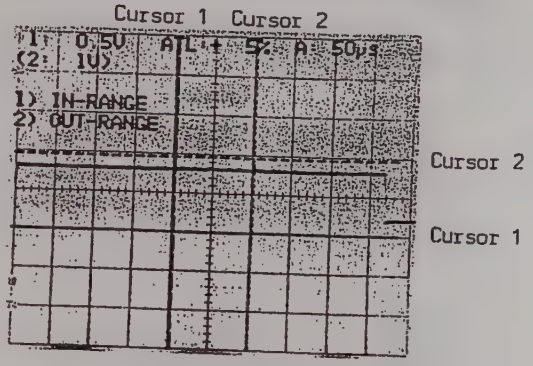
⑤ Press [0], and the following is displayed.




"H. Cursors" Adjustment

⑥ Adjust the horizontal positions of cursors with [CURSOR 1] and [CURSOR 2] keys.

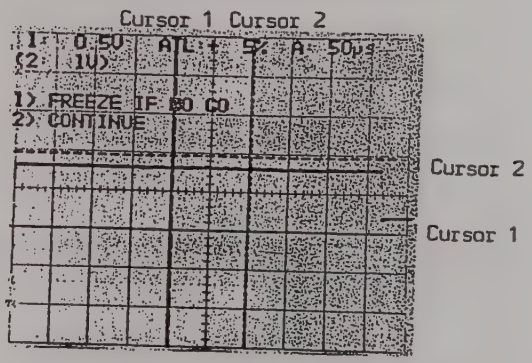
⑦ Press [0], and the following is displayed.




"IN or OUT RANGE" Selecting

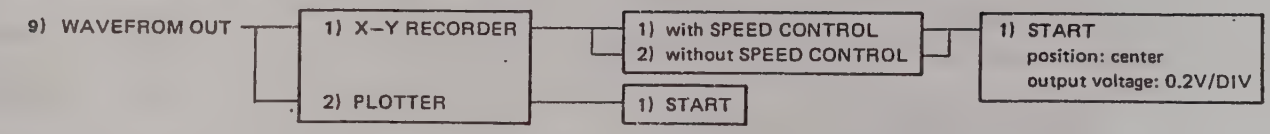
1) IN-RANGE
The range between two cursors is subject to NO GO operation.
2) OUT-RANGE
The range outside of two cursors is subject to NO GO operation.

⑧ Press [1] (IN-RANGE GO is selected), and the following is displayed.



## 3-7-9 WAVEFORM OUT

MENU




Using a X-Y recorder or a plotter (SR-6602, SR-6620, or SR-6625 manufactured by Iwatsu Electric Co., Ltd.), hardcopies of waveforms on the CRT can directly be obtained.

### Output Operations on X-Y recorder

——— Settings on the Rear Panel ———

① Turn STORAGE/REAL on switch on the rear panel to STORAGE.

——— Connection to the X-Y recorder ———

② Connect X OUT, Y OUT, and PEN UP on the rear panel of the DS-6121 to X INPUT, Y INPUT, and PEN UP INPUT of the X-Y recorder with cables, respectively.

——— Settings on the X-Y Recorder ———

③ Adjust the deflection factor and pen position of the X-Y recorder.
Deflection factor: Both X and Y outputs of DS-6121 are in the unit of 0.2 V per one DIV on the CRT.
Pen position: This is because both X and Y outputs of DS-6121 are zero volt, which corresponds to the center of the CRT, until the recorder is started by pressing [1] key.

——— Key Operations ———

④ Press [9] on the GUIDE MENU and the following is displayed.

```
1) X-Y RECORDER
2) PLOTTER
```

⑤ Press [1] and the following is displayed.

```
1) with SPEED CONTROL
2) without SPEED CONTROL
```

The X-Y recorder draws the graduated scale. Also, two pen speeds are available.

⑥ Select the pen speed. Press [1] or [2] and the following is displayed.

```
1) START
```

POSITION: Center
Output voltage: 0.1 V/DIV

⑦ Press [1] and the recorder is started.

## Output Operations on the Plotter

——— Settings on the Rear Panel ———

① When GP-IB is to be used, set any one of INSTRUMENT ADDRESS switches 1 to 5 to "one" side.

——— Attachment of Package ———

② Insert GP-IB or RS-232-C package to the hole on the rear panel, and connect it to the plotter with a relevant cable.

——— Settings on the Plotter ———

③ When the SR-6620 model is to be used, set the stepsize at 0.1 mm.

④ Adjust the plotter pen position.

——— Key Operations ———

⑤ Press [9] on the GUIDE MENU and the following is displayed.

1) X-Y RECORDER
2) PLOTTER

⑥ Press [2] and 1) START is displayed.

⑦ Press [1] and the plotter is started.

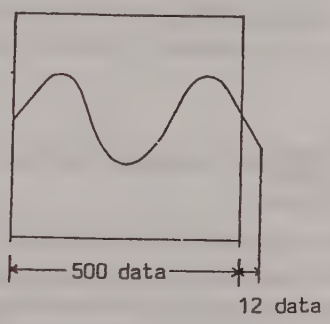
### Setting of HORIZONTAL POSITION

Though the horizontal position of waveform on CRT will be moved by [POSITION ◁ ▷] and [FINE ◁ ▷], the horizontal position of waveform plotted in an X-Y recorder or a plotter will not move. Therefore, the waveforms on CRT and that plotted on an X-Y recorder or a plotter may differ in horizontal position.

To move the horizontal position plotted on an X-Y recorder or a plotter, set [HORIZ DISPLAY] to A, move it by CH 1 POSITION and change to X-Y mode.

### On the Range of Plot

In an X-Y recorder and a plotter, the plot will go beyond the right-end scale by 12 data as shown in the figure below.



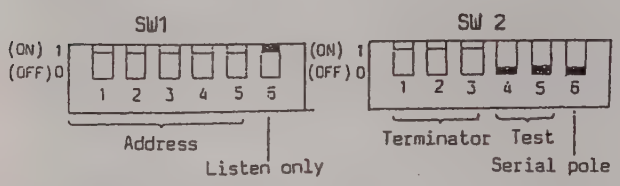

### On the Character Display of Plotter

Some characters plotted by a plotter may differ from those on CRT.

| On CRT | On Plotter |
|---|---|
| ≒ | ! |
| ↓ | - |

## Plotter setting

Set the plotter's SW1 and SW2 as shown in Figure below.




Address (SW1 to 5): Option
Listen only (SW1 6): ON
Terminator (SW2 1 to 3): Same as delimiter of DS-6121
Test (SW2 4 and 5): OFF
Serial pole (SW2 6): OFF

### Caution on SR-6602

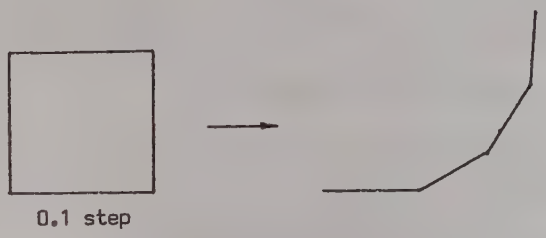
*Each time the SR-6602 plotter is used with the DS-6121, you must manually initialize operation as follows:*

*Procedure*

1 *Press* [QUIT LOCAL] *key, the plotter pen is set to HOME POSITION:*
2 *Turn the SR-6602's POWER switch off.*
3 *Set the pen position to initial setting position (Refer to the SR-6602's instruction manual.)*

## Connection to SR-6620 or SR-6625

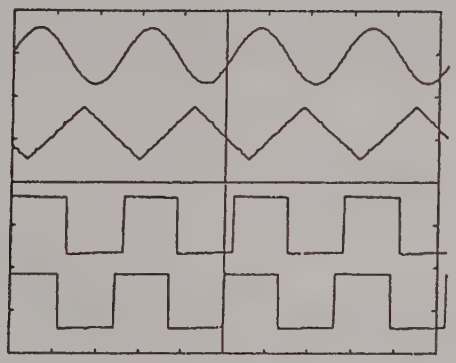
When used with SR-6620 or set the stepsize changeover pin inside the plotter to 0.1 mm (see the next page). Otherwise, a square frame will be drawn as shown below.



## Example for Construction

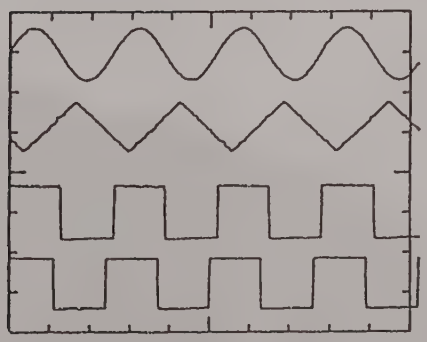
### 1) Plotter

DS-6121



CH1 0.1V /DIV
CH2 0.1V /DIV
1ms /DIV
REF1 0.1V /DIV 1ms /DIV
REF2 0.1V /DIV 1ms /DIV

### 2) X–Y recorder



MEMO

# Section 4 GP-IB Interface (Option)

## 4-1 GENERAL

By inserting the Interface Unit DS-502 into DS-6121 (hereafter called the instrument), control of such function as writing, reading, etc. is enabled by using an external controller.
Its specification is in compliance with IEEE std. 488-1978, electronically and mechanically.

### 4-1-1 Specifications of GP-IB

Input/Output signal

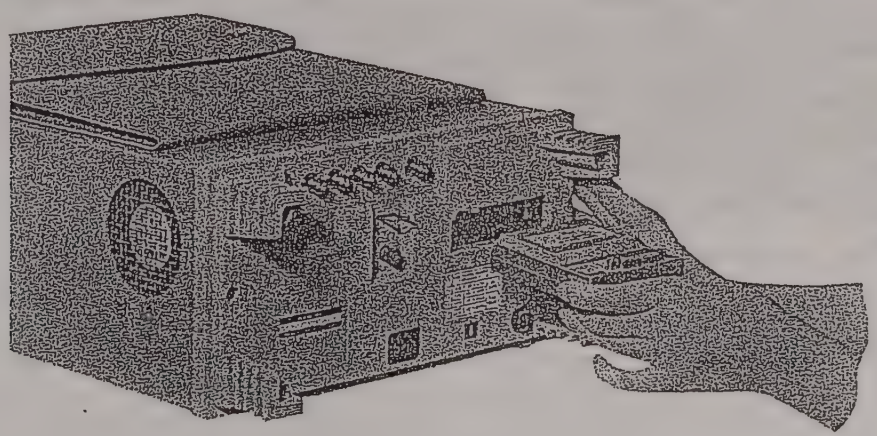
| | | |
|---|---|---|
| Input | TTL level | Active low |
| Output | TTL level | Active low |

Up to 15 instruments are connectable in one system
<Note> (The number of instruments connected) × 2 m should not exceed 20 m.
The length of the cable
The total length of the cable, 2 m × (the number of connected instrument) should not exceed 20 m.

**Caution**

*This instrument is to be used preferably under conditions which are relatively good electrically and physically.*

Figure 4-1. Installation of the DS-502



## 4-1-2 Construction

The instrument can be connected to the following equipment via GP-IB.

1. Digital Storagescope DS-6121
2. Printer
3. Plotter *1 (SR-6602 SR-6620, SR-6625)
4. Other controllable equipment by GP-IB

*1 The plotters are connectable without external controller.

## 4-1-3 Function Subsets

Subsets functions of the instrument are shown in the Table 4-1-3.

Table 4-1-3.

| Subset | Interface Function | Description |
|---|---|---|
| SH 1 | Source Handshake | Complete capability |
| AH 1 | Acceptor Handshake | Complete capability |
| T6 | Talker | Basic talker, Serial poll, Unaddress if MLA, Talk only mode |
| L4 | Listener | Basic listener, Unaddress if MTA |
| SR 1 | Service Request | Complete capability |
| RL 1 | Remote Local | Complete capability |
| PP 0 | Parallel Poll | No capability |
| DC 1 | Device Clear | Complete capability |
| CO | Controller | No capability |
| TE0 | Talker Address Extension | No capability |
| LE0 | Listener Address Extension | No capability |

## 4-1-4 Signal Line and the Number of Connector Pin

Shown in Table 4-1-4 is the signal line of input/output signals and the number of connector pin, and in Figure 4-1-4 the number and position of the connector pin.

Table 4-1-4. Signal Line and the Number of Connector Pin

| Connector Pin Number Number | Signal Line | Purpose for Use |
|---|---|---|
| 1 | DIO 1 | (LSB) |
| 2 | DIO 2 | |
| 3 | DIO 3 | Input/output of data |
| 4 | DIO 4 | |
| 5 | EOI | Shows the end of transmitted data |
| 6 | DAV | |
| 7 | NRFD | Used for handshaking |
| 8 | NDAC | |
| 9 | IFC | Interface Clear Signal from the System Controller |
| 10 | SQR | Service Request line from each instrument |
| 11 | ATN | Shows command mode or data mode of DIO line |
| 12 | GND | GND |
| 13 | DIO 5 | |
| 14 | DIO 6 | Input/output of data |
| 15 | DIO 7 | |
| 16 | DIO 8 | |
| 17 | REN | Switch of Remote/Local |
| 18 | GND | |
| | GND | GND |
| 24 | GND | |

**Signal Line**

Signal line in Table 4-1-4 is explained in the following:

1. Data line
   DIO 1 to DIO 4
   Used for data input/output.

2. Handshake line
   DAV (DATA VALID)
   NRFD (NOT READY FOR DATA)
   NDAC (NOT DATA ACCEPTED)
   These three signals are controlled automatically inside, and will not be explained here.

3. Interface Control Line
   ATN (ATTENTION)
   A signal to distinguish a message from controller.
   1 indicates an interface message, and 2 indicates a device message.

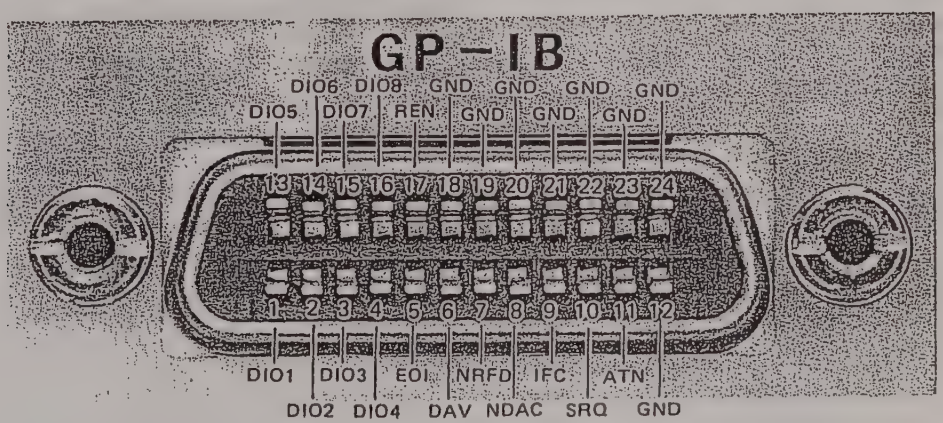
IFC (INTERFACE CLEAR)
Transmitted from the controller, and put TALKER and LISTENER in the idle state.

SRQ (SERVICE REQUEST)
Interruption signal to the controller.

REN (REMOTE ENABLE)
Transmitted from the controller, and together with other messages, used for switching of REMOTE/LOCAL.
1: Indicates that REMOTE/LOCAL control is enabled by an interface message.
2: Switches the mode to LOCAL.

EOI (END OF IDENTIFY)
When the instrument is the TALKER, DOI will be outputted together with the final byte.

Figure 4-1-4. GP-IB Connector and Pin Assignments


GP-IB
DIO6 DIO8 GND GND GND GND
DIO5 DIO7 REN GND GND GND
13 14 15 16 17 18 19 20 21 22 23 24
1 2 3 4 5 6 7 8 9 10 11 12
DIO1 DIO3 EOI NRFD IFC ATN
DIO2 DIO4 DAV NDAC SRQ GND

## 4-2 ADDRESSING

Turning switchs on the GP-IB unit•DS-502, ADDRESS, DELIMITER, and TALK ONLY is set.

### 4-2-1 ADDRESS Setting ($2^0$, $2^1$, $2^2$, $2^3$, $2^4$)

Address is set using 5-bit switches of 5 to 1. Setting is done in binary, and 5 to 1 have weights of $2^4$ to $2^0$, respectively.

> **Caution**
>
> *Address number 31, that is, setting all of the five bits to 1, is not allowed in specifications of the instrument. This is because setting all bits to 1 corresponds to the unlisten or untalk state.*

Table 4-2-2. Delimiter Setting

| .Address No. | 54321 |
|---|---|
| 0 | 00000 |
| 1 | 00001 |
| 2 | 00010 |
| 3 | 00011 |
| 4 | 00100 |
| 5 | 00101 |
| ⋮ | ⋮ |
| 25 | 11001 |
| 26 | 11010 |
| 27 | 11011 |
| 28 | 11100 |
| 29 | 11101 |
| 30 | 11110 |

### 4-2-2 DELIMITER Setting

Using D1 and D2, the kind of delimiter upon data input/output is set.

Table 4-2-1. Address Setting

| D2 | D1 | Delimiter |
|---|---|---|
| 0 | 0 | LF |
| 0 | 1 | LF |
| 1 | 0 | CR |
| 1 | 1 | CR LF |

LF : Line Feed
CR : Carriage Return

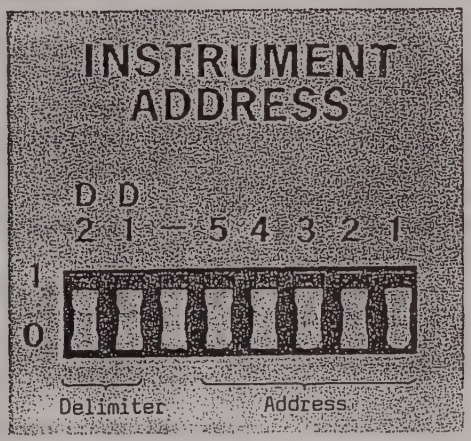
### 4-2-3 TALK ONLY Setting

By setting one of the 1 to 5 switches at ON and conducting key operations on the front panel (see 3-7-10). TALKONLY mode is activated. This mode is used for taking hard copies of the display on the screen with plotter, SR-6602, SR-6620, SR-6625 (Iwatsu Electronic Co., Ltd.) without the controller.

**Note on EOI**

When the instrument is the TALKER, EOI is outputted without fail. When the instrument is the LISTENER, disregards EIO.

Figure 4-2. Instrument Address Switch




Address

1: Address ($2^0$) = 1
2: Address ($2^1$) = 2
3: Address ($2^2$) = 4
4: Address ($2^3$) = 8
5: Address ($2^4$) = 16

} The sum of the numerical values corresponding to the relevant switches which are in 1 (ON) position will become the address of the instrument.

The setting in this figure is 01010, and the address number is 10.

Delimiter

The setting in this figure is CR LF.

## 4-3 FUNCTION

### 4-3-1 Outline

The instrument has the following functions.

a. **Data transmission**

(a) Data Read-out
Information on panel setting can be outputted collectively. The waveform data can be outputted.

(b) Data Writing
Panel setting information can be inputted collectively. The waveform data can be inputted in special regions.

b. **Panel operations**

The panel operations can be done separately or collectively. Information on panel setting is outputted separately or collectively.

c. **Status Output**

Service Request is outputted when the operation of the instrument is completed or an error occurred.
The status byte which shows the cause of Service Request is outputted with serial poll by an external controller.

d. **Control message responses**

Refer to Table 4-3-5 (4-9 page).

### 4-3-2 Data Transmission

a. **This function are classified into the following four kinds:**

① Collective read-out of SET-UP data (panel setting information)
② Read-out of displayed waveform data
③ Collective writing of SET-UP data
④ Writing of displayed waveform data

b. **The transferred contents to be the object of transfer are:**

SET-UP data: Same as individual operations in "4-3-3 Panel Operations".
Displayed waveform data: Waveform data (main information), waveform auxiliary information

c. **Collective read-out and writing of SET-UP data**

By reading out and storing several kinds of contents of manual setting by using collective read-out, necessary settings are easily realized without considering combination of individual operations.
However, contents of collective read-out are internal codes (table) and basically not open to the users.

d. **Number of data for waveform data**

CAPTURE memory captures 2048 data in any sweep range and transfers these to external device.
In the range slower than 10 µS/div (5 µS/div in Norm mode, 1 channel operation, screen and data length may match, but in the range faster than 5 µS/div (2 uS/div in Norm mode, 1 channel operation) they may not match. For example, in 5 µS/div, the first 1024 data may correspond with the screen. In other words, in the range faster than 10 µS/div sampling in always in 20 MHz clock, (40 MHz clock in the range faster than 5 uS/div in the Norm mode, 1 channel operation), 2048 data are captured and they are trnasmitted to external devices.

e. **Waveform auxiliary information**

The waveform auxiliary information is used in the following cases.

① When DS-6121 is connected to other equipments made by Iwatsu (SM-2700, etc.):
These external equipments will use the waveform auxiliary information for processing.

② When the user wants to know the sampling block and vertical axis sensitivity of the waveform data:
The sampling block or vertical axis sensitivity cannot be read out from SET-UP data. As mentioned before, this is because SET-UP data are external codes and not open to users.

The contents transmitted and their order are as shown in the following table.

| Order | Contents | Format |
|---|---|---|
| 1 | Number of waveform auxiliary information | AA ) 6 ) |
| 2 | Type of binary data | AB ) 2 ) |
| 3 | Data of length | AC ) 2 ) |
| 4 | Δx | AD ) 2.5E-6 ) |
| 5 | Y-FULL SCALE | AE ) 0.1024 ) |
| 6 | DELAY value | *1 AF ) 0 ) |

*1 Identification code

Two alphabet letters: Identification code
) : Delimiter

(Description)

1. Number of waveform auxiliary information
   For DS-6121, they are six and the number is fixed.
2. Type of binary data
   Binary data of waveform data (main information).
   0 : Binary transmit mode ineffective (ASCII)
   2 : 2 bytes/1 data
3. Data length
   The length of waveform data.rm data.
   1 : 1024
   2 : 2048
4. Δx
   This is a sampling clock cycle when the waveform is captured.
   The display is with exponential format and the unit is [sec.].
   Example: 2.5E-6 → Sampling cycle of 2.5 μS (Equivalent to 0.5 mS/div)
5. Y-FULL SCALE
   This is the full-scale value of vertical (Y) axis.
   The unit for this value is volt (V).
   Example: 0.1024 → 0.1024V full-scale (equivalent to 10 mV/div)

**Example of reading out of waveform auxiliary information**

Example: Reading out of waveform auxiliary information for CH 1
JX M10, 7

You cannot write waveform auxiliary information.
In other words, IX M10, 7 is impossible.

### 4-3-3 Panel Operations

Individual panel operations can be performed. The operation procedure is the same as the manual operation procedure. The lamps (LEDs) on the panel in the individual operation mode operate in the same way as manual operation.

a. **The following individual operations can be performed:**
Measuring condition setting
Display
Output
Processing

b. **Restrictions**
The following are excepted from individual operations:
Power ON/OFF
A INTENSITY
CHARACTER INTENSITY
ENHANCE
BEAM FIND
FOCUS
ASTIG
SCALE
TRACE ROTATION

> **Caution**
>
> *Collective setting (writting) or read-out of panel operations can be performed by following the item 4-3-2.*

### 4-3-4 Status Output

This function is to inform the state of internal operation such as error occurrence and operation completion to the external controller by SRQ signal and status byte.

**SRQ and STATUS Occurrence**

1. **Cause of SRQ Occurrence**
Causes of SRQ occurrence can be classified into the following two:
Occurrence of error
Normal completion of operation
a) Occurrence of error
In receipt of undefined GP-IB command
Parameter error of GP-IB
When GP-IB command is non-executable
Too long word-length of GP-IB command
b) Normal completion of operation
Completion of pause of averaging
Completion of capture of observed signal

2. **STATUS BYTE**
The outline of details of causes of SRQ occurrence described in 1 above can be known if the external controller reads the STATUS BYTE by serial polling.
Content of STATUS BYTE is described in the following:

| $b^8$ | $b^7$ | $b^6$ | $b^5$ | $b^4$ | $b^3$ | $b^2$ | $b^1$ |
|---|---|---|---|---|---|---|---|

b8: not used
b7: 0 no request 1 requested
b6: 0 normal 1 error
b5: undefined GP-IB command was received
b4: parameter error in GP-IB command
b3: GP-IB command is not executable
b1: Too long word-length of GP-IB command

→Relevant GP-IB command will be ignored.

3. **Clearing of SRQ and STATUS BYTE**
a) Clearing of SRQ
Serial poll sequence was conducted when DCL, and SDC was received
b) Clearing of STATUS BYTE
When DCL, and SDC was received
When the relevant cause disappeared

### 4-3-5 Control Message Responses

The following table shows the details of control messages.

Table 4-3-5. Details of Control Messages

| Message | Response from Instrument |
|---|---|
| IFC | Initialize the interface, and LISTENER and TALKER functions are set in idle state. |
| REN | Remote operation is enabled when MLA was simultaneously transmitted. |
| ATN | Receives the data on a bus as an interface message and responds to it. |
| EOI | Used as an end signal of a record for data transmission. |
| DCL, SDC | Initialization of instrument and clearing of SQR. |
| SPE, SPD | Conducts serial poll operation and transmit the status byte. |
| UNL | Clears LISTENER mode and interrupts data transmission. Operation is resumed when LISTENER mode is specified again. |
| UNT | Clears TALKER mode and interrupts data transmission. Operation is resumed when TALKER mode is specified again. |
| MLA | If the current mode is TALKER, this is cleared and switched to LISTNER mode. If it is during data transfer, the transmission terminates compulsorily. |
| MTA | If the current mode is LISTNER, this is cleared and switched to TALKER mode. If it is during data transfer, the signal receiving is terminated compulsorily. |
| DAV, NRFD, NDAC | Data is transmitted by three-line handshaking. |
| GTL | The same operation is conducted as when the panel key was pressed. Clears the lock of panel key and place the systemin LOCAL mode. |
| LLO | Manual operation to change the mode to LOCAL works no longer. |

## 4-4 DETAILS OF GP-IB COMMANDS

### 4-4-1 Waveform Data Read Command

**Function:** To read data from files to the GP-IB.
The data read out by this command are:
Setup data
Waveform data
Auxiliary information of waveform data

**Format**

**Parameters**

a. File
- Input buffer memory file M10, M11
- Current setup file S

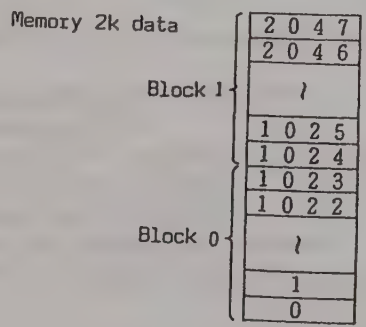
b. Format
- Data record format for data transfer
- Set value

| Format | Code | Data Expression | No. of Bytes for a String | Record Discriminator |
|---|---|---|---|---|
| 1 | ASCII | Integer | 8 bytes max. | LF, CR or CR LF |
| 3 | Binary | 1 word | 2 bytes | 2 bytes |
| 7 | ASCII | Combination | Variable | LF, CR or CR LF |

<Note> Combination in the data expression column means a combination of an integer, real number, floating decimal point, and alphanumerics.

c. Size
Parameter that specifies the size of main information to be read out from a file in units 1k words
Set values: 1 or 2 1: 1k words
2: 2k words

d. Block
Transfer start block number
Parameter that specifies a file block number to start reading main information
. Set value 0 or 1
<Note> If block 1 is specified, the preceding parameter's <size> will always be 1.
Block size: 1 word
Block numbers 0 and 1 to be assigned every kilo-bytes, starting with the smallest address number.



**Caution**

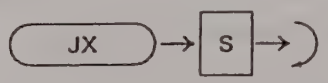
*The following three combinations of size and block are allowed.*

| *Size* | *Block* |
|---|---|
| *1* | *0* |
| *1* | *1* |
| *2* | *0* |

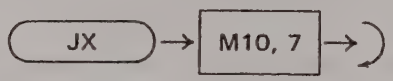
**JX commands**

The following seven types are allowed concerning "JX" command.

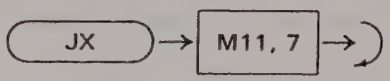
(1) Current setup internal code is transferred.



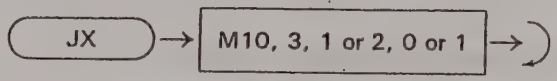

(2) Auxiliary information on the data stored in buffer memory 1 is sent. Format 7 is specified.



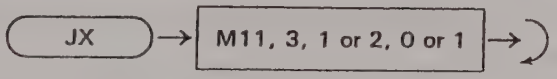

(3) Auxiliary information on the data stored in buffer memory 2 is sent. Format 7 is specified.



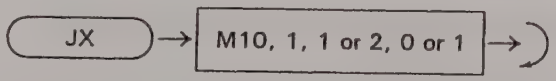

(4) The data stored in buffer memory 1 is transferred in binary code.



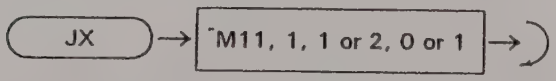

(5) The data stored in buffer memory 2 is transferred in binary code.




(6) The data stored in buffer memory 1 is transferred in ASCII code.




(7) The data stored in buffer memory 2 is transferred in ASCII code.



## 4-4-2 Waveform Data Write Command

Function: To write data from the GP-IB to files.
The data written by this command are:
Setup data
Waveform data

Format

Parameters

a. File
- Input buffer memory file M10 (CH 1), M11 (CH 2)
- Current setup file S

b. Format
- Data record format for data transfer
- Set value

| <Format> | Code | Data Expression | No. of Bytes for a String | Record Discriminator |
|---|---|---|---|---|
| 1 | ASCII | Integer | 8 bytes max. | LF, CR or CR LF |
| 3 | Binary | 1 word | 2 bytes | 2 bytes |
| 7 | ASCII | Combination | Variable | LF, CR or CR LF |

<Note> Combination in the data expression column means a combination of an integer, reel number, floating decimal point, and alphanumerics.

c. Size
Parameter that specifies the size of main information to be read out from a file in units 1k words
Set values: 1 or 2 1: 1k words
2: 2k words

d. Block
Transfer start block number
Parameter that specifies a file block number to start reading main information
. Set value 0 or 1
<Note> If block 1 is specified, the preceding parameter's <size> will always be 1.

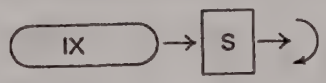
**Caution**

*No IX for auxiliary information.*

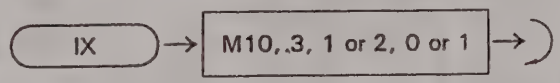
**IX commands**

The following five types are allowed concerning "IX" command.

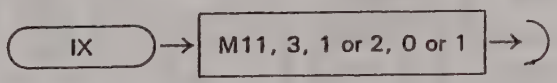
(1) Current setup internal code is transferred.



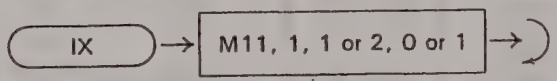

(2) The data stored in buffer memory 1 is transferred in binary code.



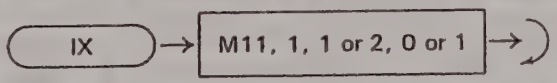

(3) The data stored in buffer memory 2 is transferred in binary code.



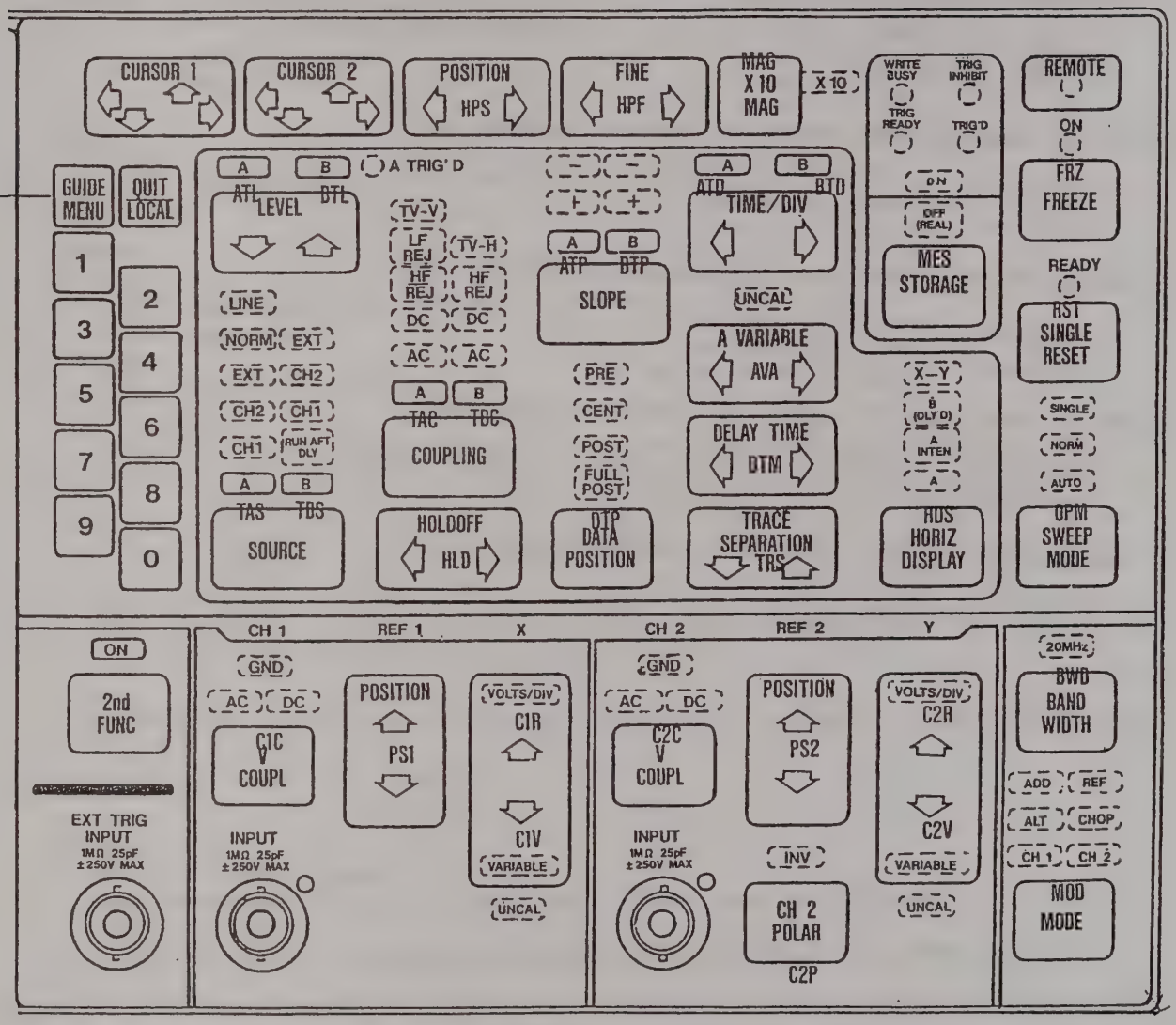

(4) The data stored in buffer memory 1 is transferred in ASCII code.




(5) The data stored in buffer memory 2 is transferred in ASCII code.



## Corresponding List (panel key to GP-IB command)



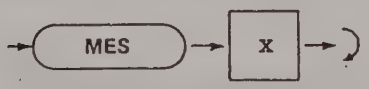

<Note> GP-IB commands are shown in red.

| | |
|---|---|
| Cursor Measurement | CUR |
| SETUP RECALL/SAVE | STU |
| WAVEFORM RECALL | WFM 1 |
| SAVE | WFM 2 |
| MOVE | WFM 3 |
| CURVE INTERPOLATION | IPL |
| CALCULATION | CAL |
| GO/NO JUDGEMENT | |
| a. Cursor-Cursor | YNC |
| b. Waveform-Cursor | YNW |
| AVERAGING | AVR |
| EQU-SAMPLING | EQS |

## 4-4-3 Individual Panel Operation

### (1) MEASURING MODE

**Format**

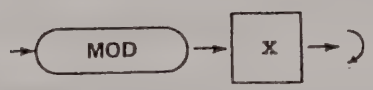



**Parameter**

| X | Storage on or off |
|---|---|
| 0 | OFF (Real) |
| 1 | ON (STORAGE) |

### (2) VERTICAL MODE

**Format**



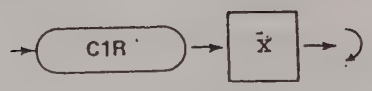

**Parameter**

| X | Mode |
|---|---|
| 1 | CH1 |
| 2 | CH2 |
| 3 | ALT |
| 4 | CHOP |
| 5 | ADD |
| 6 | CH1 & CH2 |
| 7 | CH1 CH2 & REF |

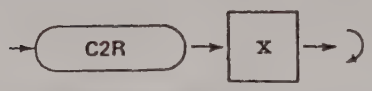
### (3) VOLTS/DIV

**Format**

CH1




CH2



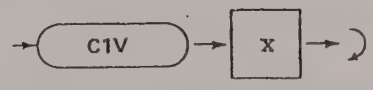

**Parameter**

| X | VOLTS/DIV |
|---|---|
| 1 | 1 mV |
| 2 | 2 mV |
| 3 | 5 mV |
| 4 | 10 mV |
| 5 | 20 mV |
| 6 | 50 mV |
| 7 | 0.1 V |
| 8 | 0.2 V |
| 9 | 0.5 V |
| 10 | 1 V |
| 11 | 2 V |
| 12 | 5 V |

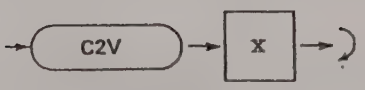
### (4) VARIABLE

**Format**

CH1




CH2

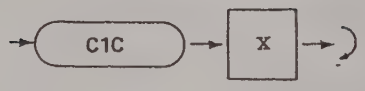



**Parameter** $0 \leqq X \leqq 255$

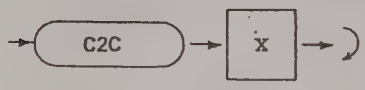
### (5) COUPLING

**Format**

CH1




CH2




**Parameter**

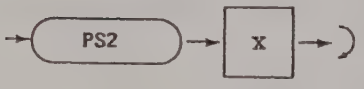
| X | Coupling |
|---|---|
| 0 | AC |
| 1 | GND |
| 2 | DC |

### (6) Vertical POSITION

**Format**

CH1

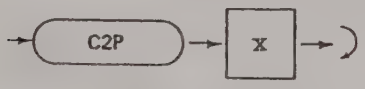
CH2




**Parameter** $-1024 \leqq x \leqq +1023$

### (7) CH2 POLARITY

**Format**

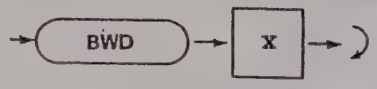



**Parameter**

| X | Normal or Invert |
|---|---|
| 0 | NORMAL |
| 1 | INVERT |

### (8) BANDWIDTH

**Format**

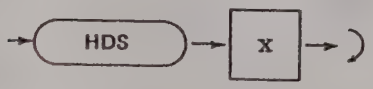



**Parameter**

| X | Bandwidth |
|---|---|
| 0 | OFF |
| 1 | ON (20 MHz) |

### (9) HORIZ DISPLAY

**Format**

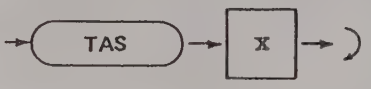



**Parameter**

| X | Horiz Display |
|---|---|
| 1 | A |
| 2 | A INTEN |
| 3 | A INT & B (DLY'D) |
| 4 | B (DLY'D) |
| 5 | X–Y |

### (10) A TRIGGER SOURCE

**Format**

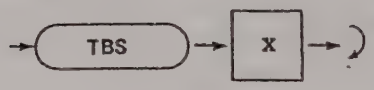



**Parameter**

| X | A Trigger Slope |
|---|---|
| 1 | CH1 |
| 2 | CH2 |
| 3 | EXT |
| 4 | NORM |
| 5 | LINE |

### (11) B TRIGGER SOURCE

**Format**



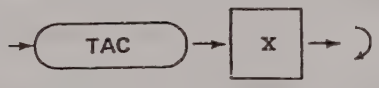

**Parameter**

| X | B Source |
|---|---|
| 0 | RUN AFTER DELAY |
| 1 | *1 CH1 |
| 2 | *1 CH2 |
| 3 | *1 EXT |

*1 Setting B TRIGGER to CH1, CH2 or EXT and A TRIGGER SOURCE to TV-V, B TRIGGER SOURCE will be set to TV-H.

### (12) A TRIGGER COUPLING

**Format**

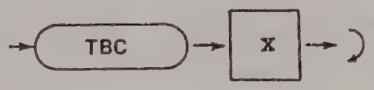



**Parameter**

| X | A Trigger Source |
|---|---|
| 1 | AC |
| 2 | DC |
| 3 | HF REJ |
| 4 | LF REJ |
| 5 | TV – V |

### (13) B TRIGGER COUPLING

**Format**

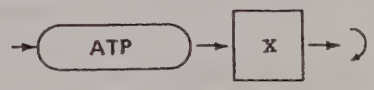



**Parameter**

| X | B Trigger Coupling |
|---|---|
| 1 | AC |
| 2 | DC |
| 3 | HF REJ |

### (14) A TRIGGER SLOPE

**Format**




**Parameter**

| X | A Trigger Slope |
|---|---|
| 0 | + |
| 1 | – |

### (15) B TRIGGER SLOPE

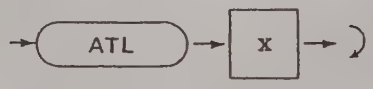
**Format**

**Parameter**

| X | B Trigger Slope |
|---|---|
| 0 | + |
| 1 | – |

### (16) A TRIGGER LEVEL

**Format**




**Parameter** $-100 \leqq X \leqq +100$

### (17) B TRIGGER LEVEL

**Format**

**Parameter** $-100 \leqq X \leqq +100$

### (18) A TIME/DIV

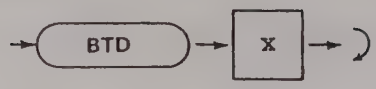
**Format**

**Parameter**

| X | TIME/DIV | X | TIME/DIV |
|---|---|---|---|
| 0 | EXT CLOCK | 14 | 0.5 ms |
| 1 | 10 s | 15 | 0.2 ms |
| 2 | 5 s | 16 | 0.1 ms |
| 3 | 2 s | 17 | 50 μs |
| 4 | 1 s | 18 | 20 μs |
| 5 | 0.5 s | 19 | 10 μs |
| 6 | 0.2 s | 20 | 5 μs |
| 7 | 0.1 s | 21 | 2 μs |
| 8 | 50 ms | 22 | 1 μs |
| 9 | 20 ms | 23 | 0.5 μs |
| 10 | 10 ms | 24 | 0.2 μs |
| 11 | 5 ms | 25 | 0.1 μs |
| 12 | 2 ms | 26 | 50 ns |
| 13 | 1 ms | 27 | 20 ns |

### (19) B TIME/DIV

**Format**




**Parameter**

| X | TIME/DIV | X | TIME/DIV |
|---|---|---|---|
| 7 | 0.1 s | 18 | 20 μs |
| 8 | 50 ms | 19 | 10 μs |
| 9 | 20 ms | 20 | 5 μs |
| 10 | 10 ms | 21 | 2 μs |
| 11 | 5 ms | 22 | 1 μs |
| 12 | 2 ms | 23 | 0.5 s |
| 13 | 1 ms | 24 | 0.2 s |
| 14 | 0.5 ms | 25 | 0.1 s |
| 15 | 0.2 ms | 26 | 50 ns |
| 16 | 0.1 ms | 27 | 20 ns |
| 17 | 50 μs | | |

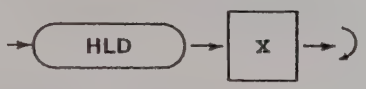
### (20) A VARIABLE

**Format**

**Parameter** $0 \leqq X \leqq 257$

### (21) HOLDOFF

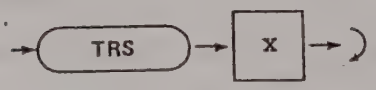
**Format**




**Parameter** $0 \leqq X \leqq 200$

### (22) TRACE SEPARATION

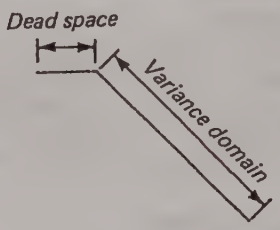
**Format**




**Parameter** $0 \leqq X \leqq 255$

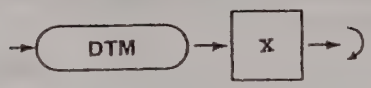
**Caution**

*TRS command "Value" does not necessarily coincide with the separation on the CRT screen because of the dead space in its initial portion, as shown in the following.*




### (23) DELAY TIME

**Format**



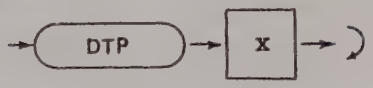

**Parameter** $0.20 \leqq X \leqq 10.20$

**Caution**

*DTM command "Value" is effective to 2nd decimal place. If it contains the third decimal place, DLY command will be ignored.*

### (24) DATA POSITION

**Format**

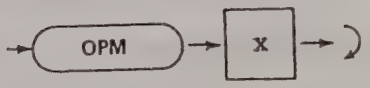



**Parameter**

| X | Data Position |
|---|---|
| 0 | FULL POST |
| 1 | POST |
| 2 | CENTER |
| 3 | PRE |

### (25) OPERATION MODE

**Format**

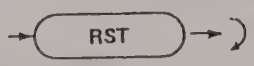



**Parameter**

| X | Operation Mode |
|---|---|
| 1 | AUTO |
| 2 | NORM |
| 3 | SINGLE |

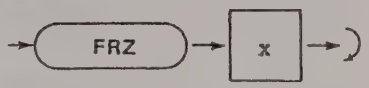
### (26) SINGLE RESET

**Format**




### (27) FREEZE

**Format**

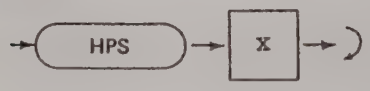



**Parameter**

| X | On or Off |
|---|---|
| 0 | OFF |
| 1 | ON |

### (28) HORIZONTAL POSITION

Format




Parameter $-128 \leqq X \leqq +127$

**Caution**

*Horizontal Position resister consists of 12 bits. Indicate the upper 8 bits by HPS and the lower 4 bits by HPF.*

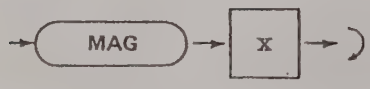
### (29) FINE (HORIZONTAL POSITION)

Format

Parameter $-8 \leqq X \leqq +7$

### (30) MAG x 10

Format

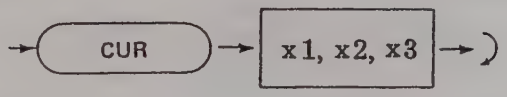



Parameter

| X | Mag x 10 On or Off |
|---|---|
| 0 | OFF |
| 1 | ON |

### (31) CURSOR MEASUREMENT

Format




Parameter

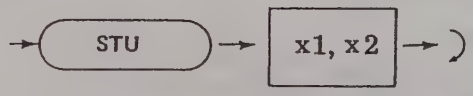
| X1 | Voltage or Time |
|---|---|
| 0 | OFF |
| 1 | ΔVOLTS |
| 2 | ΔTIME |
| 3 | ΔVOLTS ON WAVEFORM |

X2, X3

| ΔVOLTS | ΔTIME or ΔVOLTS on WAVEFORM |
|---|---|
| –512 to +511 | 0 to 2048 |

### (32) SETUP RECALL/SAVE

Format




Parameter

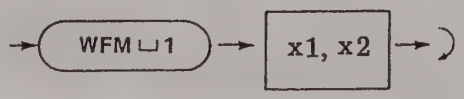
| X1 | Recall or Save |
|---|---|
| 1 | RECALL |
| 2 | SAVE |

| X2 | From or to File Name |
|---|---|
| 1 | SETUP MEM 1 |
| 2 | SETUP MEM 2 |
| 3 | SETUP MEM 3 |
| 4 | SETUP MEM 4 |
| 5 | SETUP (LAST DATA) |
| 6 | SETUP (POWER OFF) |
| 7 | DEFAULT |

## (33) WAVEFORM RECALL/SAVE

### a. RECALL

**Format**



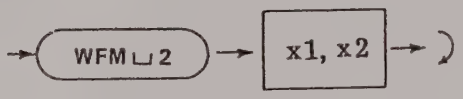

**Parameter**

| X1 | From File Name |
|---|---|
| 1 | WFM MEM 1 |
| 2 | WFM MEM 2 |
| 3 | WFM MEM 3 |
| 4 | WFM MEM 4 |

| X2 | To File Name |
|---|---|
| 3 | REF1 |
| 4 | REF2 |

### b. SAVE

**Format**



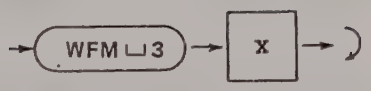

**Parameter**

| X1 | From File Name |
|---|---|
| 1 | CH1 |
| 2 | CH2 |
| 3 | REF1 |
| 4 | REF2 |

| X2 | To File Name |
|---|---|
| 1 | WFM MEM 1 |
| 2 | WFM MEM 2 |
| 3 | WFM MEM 3 |
| 4 | WFM MEM 4 |

### c. MOVE

**Format**

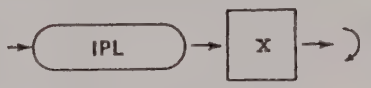



**Parameter**

| X | Content of MOVE |
|---|---|
| 1 | CH1 → REF1 |
| 2 | CH2 → REF2 |
| 3 | CH1 → REF 1 CH2 → REF2 |
| 4 | CH1 → REF2 |
| 5 | CH2 → REF1 |
| 6 | CH1 → REF2 CH2 → REF1 |

## (34) CURVE INTERPOLATION

**Format**

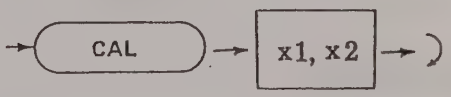



**Parameter**

| X | On or Off |
|---|---|
| 0 | OFF |
| 1 | ON |

## (35) CALCULATION (+, –, X)

**Format**




**Parameter**

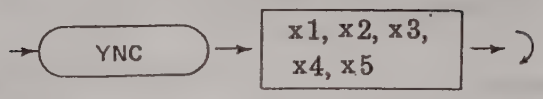
| X1 | On or Off |
|---|---|
| 0 | OFF |
| 1 | ON |

| X2 | Type of calculation |
|---|---|
| 1 | + |
| 2 | – |
| 3 | X |

### (36) GO/No Judgement

#### a. Cursor to Cursor

**Format**




**Parameter**

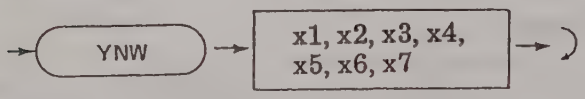
X1

| X1 | Range Selection |
|---|---|
| 0 | OFF |
| 1 | IN-RANGE |
| 2 | OUT-RANGE |

X2, X3 V cur I and II adr
$-512 \leqq X2, X3 \leqq +511$
X4, X5 H cur I and II adrs
$0 \leqq X4, X5 \leqq +2047$

#### b. Cursor to Waveform

**Format**




**Parameter**

X1

| X1 | Range Selection |
|---|---|
| 0 | OFF |
| 1 | IN-RANGE |
| 2 | OUT-RANGE |

X2, X3 H cur I and II adrs
$0 \leqq X2, X3 \leqq 2047$

X4

| X4 | File Name 1 |
|---|---|
| 1 | WFM MEM 1 |
| 2 | WFM MEM 2 |
| 3 | WFM MEM 3 |
| 4 | WFM MEM 4 |

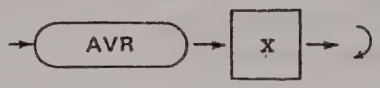
X5 Position 1
$-256 \leqq X5 \leqq +255$

| X6 | File Name 2 |
|---|---|
| 1 | WFM MEM 1 |
| 2 | WFM MEM 2 |
| 3 | WFM MEM 3 |
| 4 | WFM MEM 4 |

X7 Position 2
$-256 \leqq X7 \leqq +255$

## (37) AVERAGING

**Format**

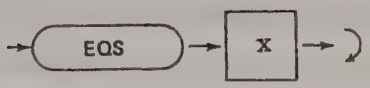



**Parameter**

| X | Number of Average |
|---|---|
| 0 | OFF |
| 1 | 2 |
| 2 | 4 |
| 3 | 8 |
| 4 | 16 |
| 5 | 32 |
| 6 | 64 |
| 7 | 128 |
| 8 | 256 |

## (38) EQUIVALENT SAMPLING

**Format**




**Parameter**

| X | On or Off |
|---|---|
| 0 | OFF |
| 1 | ON |

## 4-5 OPERATING PROCEDURES

Operating procedures are as follows.

**Procedures**

1. Set ADDRESS, DELIMITER, TALKER using the GP-IB ADDRESS switch on the DS-502.

2. Insert the DS-502 in the hole on the rear panel.

3. Connect the GP-IB multiconnector on DS-502 to the external controller (personal computer, etc.) by a cable.
   Comment
   The connector used is Model 57-20240-8D35 (manufactured by ANPHENOL/Dai-ichi Denshi Kogyo).
   Cable for 24-pin type piggyback connector (e.g. 408JE-101, 102, and 104 by ANPHENOL/Dai-ichi Denshi Kogyo) can be used.
   <Note>
   Connection to a IEC-IB connector (25-pin) requires an additional converting connector.

4. The power switch of the instrument and the external controller is turned ON.

After completion of the operation above, the instrument can be controlled using a program on the external controller with GP-IB control command of the instrument.

**Caution**

*When ADDRESS, DELIMITER, or TALKER of the instrument is to be changed, operate as in the following:*

*(1) When the power switch is ON*

*Change ADDRESS, DELIMITER or TALKER function by switches on the DS-502, and transmit DCL or SDC from the controller to place the instrument in the initial state.*

*(2) When the power switch is OFF*

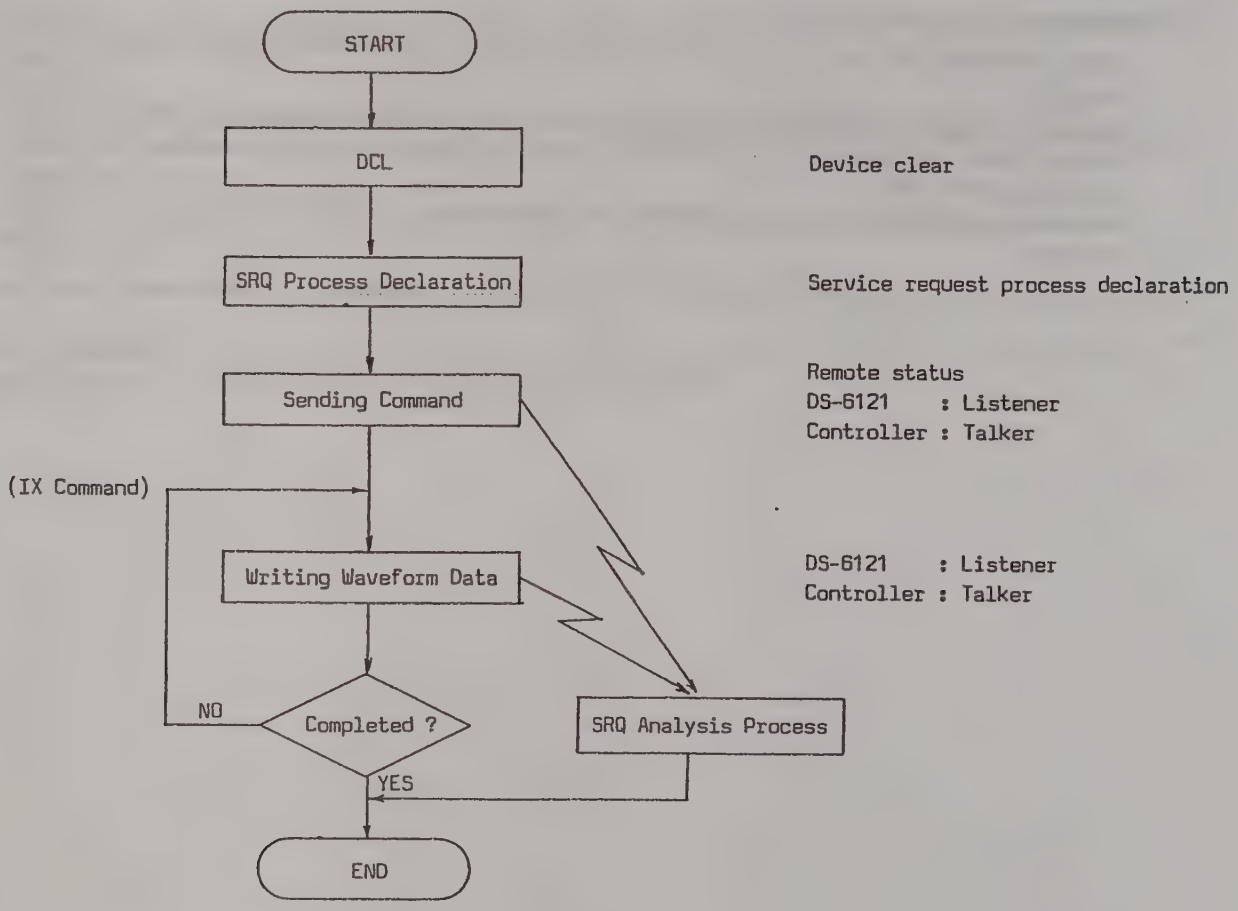
*Reset ADDRESS, DELIMITER, or KALKER function by switches on the DS-502, and turn the power ON.*

*Connection or change in connection of GP-IB connector to an external instrument should be done after confirming that power switches of all instruments, GP-IB connector as well as external instruments, are in OFF state.*
*While operating with GP-IB, all power switches of instruments connected to the bus should be in ON state.*

## 4-6 PROGRAM FLOW OF THE DS-6121 BY THE CONTROLLER

Described below is the standard procedures for controling the DS-6121 via GP-I8 interface.

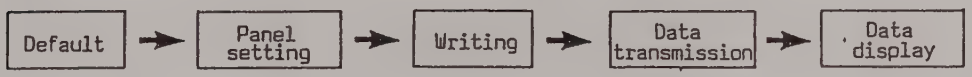
**Writing Waveform Data to DS-6121**



## 4-7 SAMPLE PROGRAM

Describes two sample programs that use the PC-9801 and HP-216 as external controller.

**Overall Operations**




### 4-7-1 PC-9801

```
10 '
20 '
30 '
40 '
50 CONSOLE 0,25,0,1
60 CLS 3
70 '
100 DIM CH1DATA%(2047),CH2DATA%(2047),CH1AUX$(11),CH2AUX$(11)
110 '
120 CMD TIMEOUT=2
130 CMD DELIM=0
140 DS%=30
150 '
160 ISET IFC
170 ISET REN
180 WBYTE &H14;
190 '
200 ON SRQ GOSUB *SRQJUMP
210 SRQ ON
220 ON ERROR GOTO *TIMEOUT
230 '
240 PRINT@ DS%;"STU 1,7"
250 GOSUB *CH1SET
260 GOSUB *CH2SET
270 GOSUB *TRGSET
280 GOSUB *TIMESET
290 GOSUB *STRSET
300 GOSUB *WRTSUB
310 GOSUB *AUXRD
315     FOR I%=0 TO 1000 : NEXT I%
320 GOSUB *CH1READ
330 GOSUB *CH2READ
340 GOSUB *WAVEDISP
350 SRQ OFF
360 STOP
400 '
410 *CH1READ
420     PRINT@ DS%;"JX M10,1,2,0"
430     FOR NUMB%=0 TO 2047
440       INPUT@ DS%;CH1DATA$ : CH1DATA%(NUMB%)=VAL(CH1DATA$)
450     NEXT NUMB%
460     RETURN
```

**Comment**

240 Recall DEFAULT setting by using SET RECALL/SAVE.

400 to 460 CH1 READ
2 kW data which is written from CH 1 of this unit is transmitted to an array decleared by Ch 1 data of the controller.

```
500 '
510 *CH2READ
520     PRINT@ DS%;"JX M11,1,2,0"
530     FOR NUMB%=0 TO 2047
540       INPUT@ DS%;CH2DATA$ : CH2DATA%(NUMB%)=VAL(CH2DATA$)
550     NEXT NUMB%
560     RETURN
600 '
610 *CH1SET
620     PRINT@ DS%;"C1R 6"
630     PRINT@ DS%;"C1C 2"
640     PRINT@ DS%;"PS1 0"
650     RETURN
700 '
710 *CH2SET
720     PRINT@ DS%;"C2R 8"
730     PRINT@ DS%;"C2C 2"
740     PRINT@ DS%;"PS2 0"
750     PRINT@ DS%;"C2P 1"
760     RETURN
800 '
810 *TRGSET
820     PRINT@ DS%;"TAS 2"
830     PRINT@ DS%;"ATP 1"
840     PRINT@ DS%;"ATL 10"
850     RETURN
900 '
910 *TIMESET
920     PRINT@ DS%;"ATD 16"
930     RETURN
950 '
960 *STRSET
970     PRINT@ DS%;"OPM 3"
980     PRINT@ DS%;"MES 1"
990     PRINT@ DS%;"DTP 2"
1000    RETURN
1050 '
1060 *WRTSUB
1070    PRINT@ DS%;"RST"
1080    *LOOP1
1090      IF S<>64 THEN GOTO *LOOP1
1100    RETURN
1150 '
1160 *AUXRD
1170    PRINT@ DS%;"JX M10,7"
1180    FOR NUMB%=0 TO 11
1190      INPUT@ DS%;CH1AUX$(NUMB%)
1200    NEXT NUMB%
1205 '    FOR I%=0 TO 1000 : NEXT I%
1210    PRINT@ DS%;"JX M11,7"
1220    FOR NUMB%=0 TO 11
1230      INPUT@ DS%;CH2AUX$(NUMB%)
1240    NEXT NUMB%
1250    RETURN
```

**Comment**

500 to 560 CH2 READ

2 kW data which is written from CH 2 of this unit is transmitted to an array declared by Ch 2 data of the controller.

600 to 650 CH1 SET

Settings related to CH 1 amplifier.

| | |
|---|---|
| Range | 50 mV/div |
| Coupling | DC |
| Position | CENTER |

700 to 760 CH2 SET

Settings related to CH 2 amplifier.

| | |
|---|---|
| Range | 0.2 V/div |
| Coupling | DC |
| Position | CENTER |
| Polarity | INVERT |

800 to 850 TRG SET

Settings realted to trigger.

| | |
|---|---|
| A trigger source | CH 2 |
| A trigger slope | - |
| A trigger level | 10% |

900 to 930 TIME SET

Settings related to time axis.

| | |
|---|---|
| A TIME/div | 0.1 ms/div |

950 to 1000 STR SET

Changes this unit to storage mode and sets the operation mode to single.

1050 to 1100 Wrtsub

Sets single reset to this unit. This instruction makes this unit a trigger wait state. When triggered, writing is started and SRQ is transmitted to the controller on completion of writing. When the controller receives an SRQ, serial polling is performed and when the number 64 is confirmed, the unit will get out of this routine.

1150 to 1250 Auxrd

Reads out auxiliary information.

```
1300 '
1310 *WAVEDISP
1320    SCREEN 3,0
1340    CLS 3
1350    GOSUB *MEASUR
1360    GOSUB *PRNAUX
1370    FOR X%=0 TO 2047 STEP 4
1380      CH1Y%=(CH1DATA%(X%)/256-129)*(-1)
1390      PSET ((X%+1)/4+62,CH1Y%),2
1400    NEXT X%
1410    FOR X%=0 TO 2047 STEP 4
1420      CH2Y%=(CH2DATA%(X%)/256-129)*(-1)
1430      PSET ((X%+1)/4+62,CH2Y%),1
1440    NEXT X%
1450    RETURN
1500 '
1510 *MEASUR
1520    LINE(63,0)-(575,257),7,B
1530    LINE(63,128)-(575,128),7
1540 '
1550    FOR I%=115 TO 523 STEP 51 : LINE(I%,0)-(I%,9),7      : NEXT I%
1560    FOR I%=115 TO 523 STEP 51 : LINE(I%,118)-(I%,138),7 : NEXT I%
1570    FOR I%=115 TO 523 STEP 51 : LINE(I%,257)-(I%,247),7 : NEXT I%
1580 '
1590    FOR I%=28 TO 231 STEP 25 : LINE(63,I%)-(73,I%),7    : NEXT I%
1600    FOR I%=28 TO 231 STEP 25 : LINE(575,I%)-(565,I%),7 : NEXT I%
1610    RETURN
1700 '
1710 *PRNAUX
1720    LOCATE 10,16 : PRINT "**** AUXILIARY INFORMATION ****"
1730    PRINT "CH1 : "; : FOR NUMB%=0 TO 11 : PRINT CH1AUX$(NUMB%)+" "; : NEXT N
UMB%
1740    LOCATE 0,19
1750    PRINT "CH2 : "; : FOR NUMB%=0 TO 11 : PRINT CH2AUX$(NUMB%)+" "; : NEXT N
UMB%
1760    COLOR@(0,17)-(79,18),2
1770    COLOR@(0,19)-(79,20),1
1780    RETURN
1800 '
1810 *TIMEOUT
1820    ERRNUMB=ERR
1830    IF ERRNUMB=128 THEN PRINT "TIMEOUT"
1840    IF ERRNUMB=131 THEN PRINT "NO ACTIV DEVICE"
1850  STOP
1900 '
1910 *SRQJUMP
1920    POLL DS%,S
1930    PRINT " **********  INTERRUPTED S = ";S
1940    SRQ ON
1950    RETURN
1960 '
1970 END
```

**Comment**

1300 to 1450 Wavedisp

Waveforms are displayed based on the data stored in the arrays Ch 1 data and Ch 2 data. However, the upper part of the waveform represents CH 1 and the lower, CH 2.

```
10     !
20     !       DS-6121 SAMPLE PROGRAM
30     !
40     !
50     Ds=730                                    ! DS-6121 GP-IB ADDRESS
60     INTEGER Ch1data(2047)
70     INTEGER Ch2data(2047)
80     !
90     ON TIMEOUT 7,2 GOSUB Timout
100    ON INTR 7 GOSUB Srq
110    ENABLE INTR 7;2
120    ABORT 7
130    CLEAR 7
140    REMOTE 7
150    !
160    OUTPUT Ds USING "K";"STU 1,7"                ! SETUP DEFALT
170    GOSUB Ch1set
180    GOSUB Ch2set
190    GOSUB Trgset
200    GOSUB Timeset
210    GOSUB Strset
220    GOSUB Wrtsub
230    GOSUB Auxrd
240    GOSUB Ch1read
250    WAIT 1
260    GOSUB Ch2read
270    GOSUB Wavedisp
280    STOP
290 Ch1read:    !
300         OUTPUT Ds USING "K";"JX M10,3,2,0"
310          ENTER Ds USING "#,W";Ch1data(*)
320         RETURN
330 Ch2read: !
340         OUTPUT Ds USING "K";"JX M11,3,2,0"
350          ENTER Ds USING "#,W";Ch2data(*)
360         RETURN
370 Ch1set: !
380          OUTPUT Ds USING "K";"C1R 6"          ! CH1 RANGE 50mV/div
390          OUTPUT Ds USING "K";"C1C 2"          ! CH1 COUPLING DC
400          OUTPUT Ds USING "K";"PS1 0"          ! CH1 POSITION CENTER
410          RETURN
420 Ch2set: !
430          OUTPUT Ds USING "K";"C2R 8"          ! CH2 RANGE .2V/div
440          OUTPUT Ds USING "K";"C2C 2"          ! CH2 COUPLING DC
450          OUTPUT Ds USING "K";"PS2 0"          ! CH2 POSITION CENTER
460          OUTPUT Ds USING "K";"C2P 1"          ! POLARITY INVERT
470          RETURN
```

**Comment**

160 Recall DEFAULT setting by using SET RECALL/SAVE

290 to 320 Ch 1 read
2 kW data which is written from CH 1 of this unit is transmitted to an array decleared by Ch 1 data of the controller.

330 to 360 Ch 1 read
2 kW data which is written from CH 2 of this unit is transmitted to an array declared by Ch 2 data of the controller.

370 to 410 Ch 1 set
Settings related to CH 1 amplifier.

| | |
|---|---|
| Range | 50 mV/div |
| Coupling | DC |
| Position | Midrange |

420 to 470 Ch 2 set
Settings related to CH 2 amplifier.

| | |
|---|---|
| Range | 0.2 V/div |
| Coupling | DC |
| Position | Midrange |
| Polarity | INVERT |

```
480 Trgset: !
490         OUTPUT Ds USING "K";"TAS 2"          ! TRIGGER A SOURCE CH2
500         OUTPUT Ds USING "K";"ATP 1"          ! A TRIGGER SLOPE -
510         OUTPUT Ds USING "K";"ATL 10"         ! A TRIGGER LEVEL 10
520         RETURN
530 Timeset: !
540         OUTPUT Ds USING "K";"ATD 16"         ! A TIME .1ms/div
550         RETURN
560 Strset: !
570         OUTPUT Ds USING "K";"OPM 3"          ! OP. (SWEEP) MODE SINGLE
580         OUTPUT Ds USING "K";"MES 1"          ! STORAGE ON
590         OUTPUT Ds USING "K";"DTP 2"          ! DATA POSITION CENTER
600         RETURN
610 Wrtsub: !
620         OUTPUT Ds USING "K";"RST"            ! SINGLE RESET
630         IF S<>64 THEN GOTO 630               ! WRITE END WAIT
640         RETURN
650 Auxrd: !
660         OUTPUT Ds USING "K";"JX M10,7"
670         FOR I=0 TO 11
680           ENTER Ds USING "K";Ch1aux$
690           PRINT Ch1aux$
700         NEXT I
710         WAIT .5
720         OUTPUT Ds USING "K";"JX M11,7"
730         FOR I=0 TO 11
740           ENTER Ds USING "K";Ch2aux$
750           PRINT Ch2aux$
760         NEXT I
770         RETURN
780 Wavedisp: !
790         GRAPHICS ON
800         WINDOW 0,2047,-256,256
810         VIEWPORT 0,400,0,200
820         MOVE 0,0
830         FOR I=0 TO 2047
840           Ch1d=Ch1data(I)/256+128
850           PLOT I,Ch1d
860         NEXT I
870         MOVE 0,0
880         FOR I=0 TO 2047
890           Ch2d=Ch2data(I)/256*(-1)-128
900           PLOT I,Ch2d
910         NEXT I
920         RETURN
930 Srq:  !
940         S=SPOLL(Ds)
950         PRINT "********** INTERRUPTED S=";S
960         ENABLE INTR 7
970         RETURN
980 Timout: !
990         DISP "** ** ** TIMEOUT ERROR ** ** **"
1000        RETURN
1010        END
```

**Comment**

480 to 520 TRG SET
Settings realted to trigger.
A trigger source CH 2
A trigger slope -
A trigger level 10%

530 to 550 Time set
Settings related to time axis.
A TIME/div 0.1 ms/div

560 to 600 Strset
Changes this unit to storage mode and sets the operation mode to single.

610 to 640 Wrtsub
Sets single reset to this unit. This instruction makes this unit a trigger wait state. When triggered, writing is started and SRQ is transmitted to the controller on completion of writing. When the controller receives an SRQ, serial polling is performed and when the number 64 is confirmed, the unit will get out of this routine.

650 to 770 Auxrd
Reads out auxiliary information.

778 to 920 Wavedisp
Waveforms are displayed based on the data stored in the arrays Ch 1 data and Ch 2 data. However, the upper part of the waveform represents CH 1 and the lower, CH 2.

MEMO

# Section 5 RS-232-C Interface (Option)

## 5-1 GENERAL

By inserting the Interface Unit DS-503 into DS-6121 (hereafter called the instrument), control of such function as writing, reading, etc. is enabled by using an external controller.

Its specification is in compliance with EIA RS-232-C electronically and mechanically.

**Installing**

Insert the unit DS-503 in a compartment on the rear panel (refer to Figure 5-1).

> **Caution**
>
> *Be sure to install the DS-503 at the power switch OFF status.*

### 5-1-1 Specifications of RS-232-C

**Asynchronous/Synchronous**
Asynchronous data communication

**Stop Bit**
1 bit or 2 bits

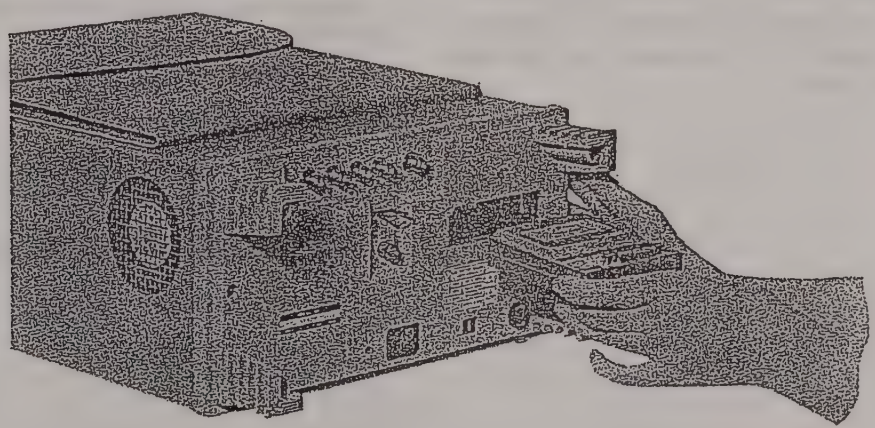
**Parity Enable**
Disabled or Enabled

**Parity Sense**
Odd parity or even parity

**Character Length**
7 bits or 8 bits

**Baud Rate**
110 BPS, 300 BPS, 600 BPS, 1200 BPS, 2400 BPS, 4800 BPS, 9600 BPS or 19200 BPS

Figure 5-1. Installation of the DS-503



## 5-1-2 Construction

The instrument can be connected to the following equipment via RS-232-C.

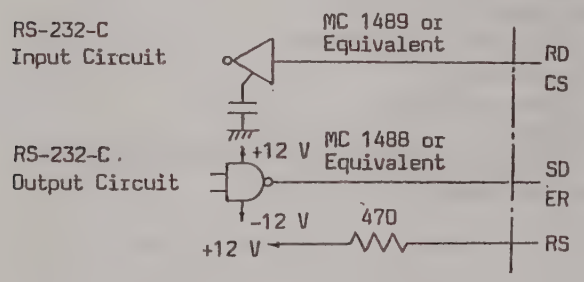
1. Digital Storagescope DS-6121/DS-6121A
2. Printer
3. Plotter *1 (SR-6602, SR-6620, SR-6625)
4. Other controllable equipment by RS-232-C

*1 The plotters are connectable without external controller.

## 5-1-3 Signal Line and the Number of Connection Pin

### Input and Output Circuits

Input and output circuits of the RS-232-C are as follows.




Shown in Table 5-1-3 is the signal line of input/output signals and the number of connector pin, and in Figure 5-1-3 the number and position of the connector pin.

Table 5-1-3. Signal Line and Pin No.

| RS-232-C Pin No. | Signal Line (Mnemonic) | I/O | Function |
|---|---|---|---|
| 1 | FG | | Frame Ground |
| 2 | SD | Out | Sent Data |
| 3 | RD | In | Received Data |
| 4 | RS | Out | Request to Send |
| 5 | CS | In | Clear to Send |
| 6 | NC | | No connection |
| 7 | SG | | Signal Ground |
| 8 ⟩ 19 | NC | | No connection |
| 20 | ER | Out | Data Terminal Ready |
| 21 ⟩ 25 | NC | | No connection |

### Signal Line

SD (Sent Data)
Mark 1 in "L" output
Space 0 in "H" output

RD (Received Data)
Logic is the same as the Sent Data.

RS (Request Data)
Requests sending for the external equipments in active "H". In this unit, "H" is always output.

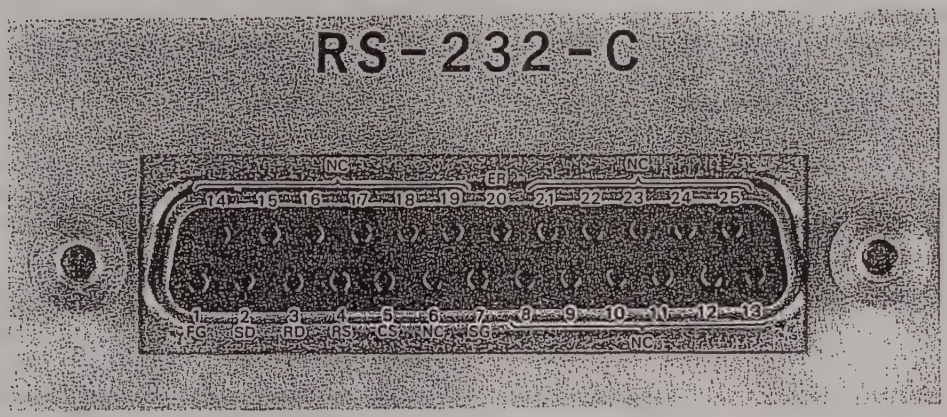
CS (Clear to Send)
Enables this unit to send in active "H" input.

ER (Data Terminal Ready)
Indicates that this unit can send or receive data in active "H" output.

FG (Frame Ground)
Grounding for maintenance to ground to the unit's frame.

SG (Signal Ground)
Common grounding for all the signals

Figure 5-1-3. Connector Pin No.



## 5-1-4 Connection to External Equipments

### Connecting Cable

Use the attached cable SX-0072 when connecting to external equipments.

The connector side is 17JE-23250-02 (D8A). The end of the cable should be adapted to the interface specifications of the external equipment after processing as shown in Figure 5-1-4-1.

### Connection of Signal Line

Connect to external equipments as shown in Figure 5-1-4-2.

### Method of Processing Cable

1 Cut the cable to the required length and remove the outer shield about 5 mm.
2 Cut the shield-weave line with remaining length of 1 cm, bend onto the shield and cover the attached tube for external equipments after soldering the lead wire for FG (Frame Ground).
3 Connect each signal line to the connecting terminal. Process the unnecessary end of the lines by covering them with heat-contractive cable.

### Connection to Plotter

When connecting to IWATSU's plotter (SR-6620, SR-6602, SR-6625), make the switch setting same as each interface for both DS-6121 and the plotter in terms of baud rate, character length, parity enable, parity sense, stop bit length and delimiter. Use the connecting cable SX-0073 (sold separately).

The output procedure for the plotter is the same as the case of use of GP-IB.

Figure 5-1-4-1. Connecting Cable SX-0072

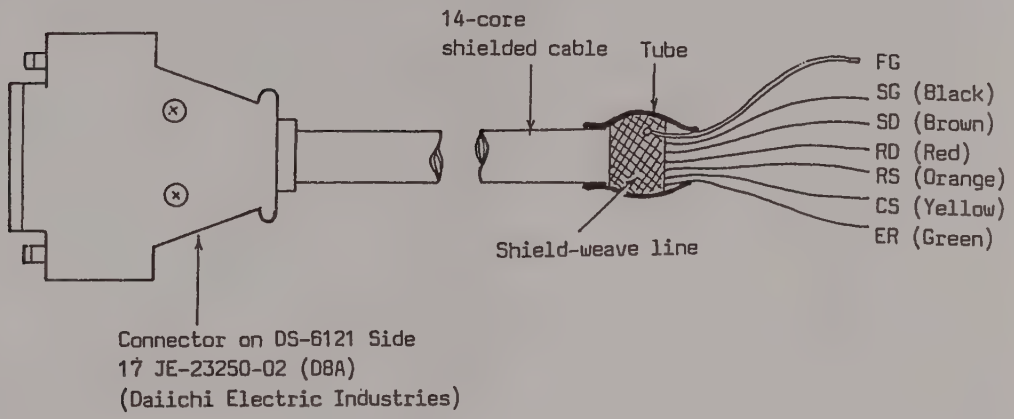
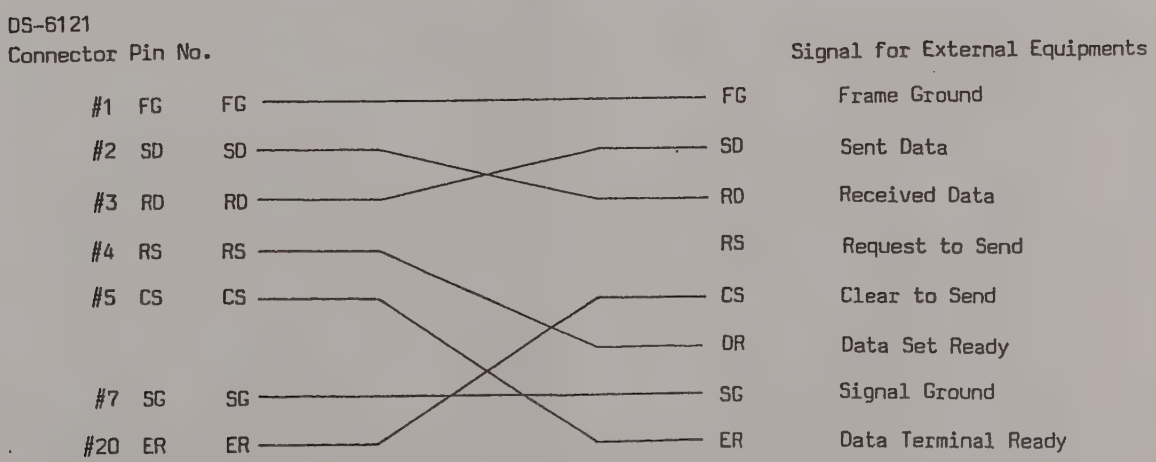


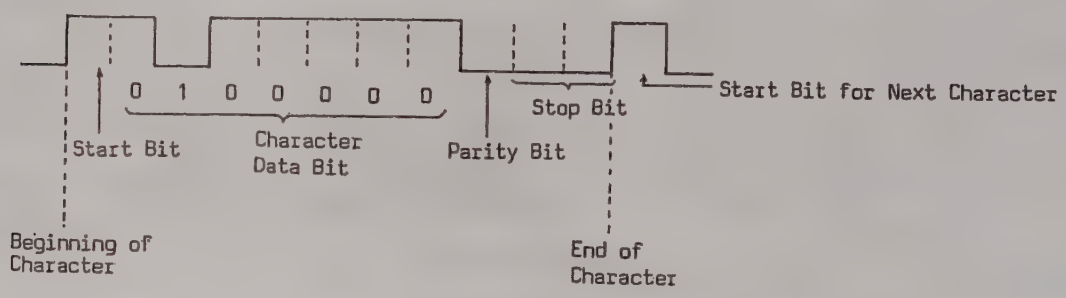

Figure 5-1-4-2. Connecting Signal Lines



## 5-1-5 Character Format, Handshake and Echo-back Process Character Format

### Character Format

An example of character frame on the data line is in the following figure.




The following is the contents of a character frame.

Start Bit

A start bit announces a receiving equipment that a new character is being send out.

Character Data Bit

A character data bit is a binary code for which the character to be transmitted. Set to 7 bits or 8 bits.

Parity Bit

A parity bit is to detect whether each bit in a character is correctly received and error is detected by making total number of bit "1" in the entire characters sent either even if odd. Set to parity enable and parity sense.

Stop Bit

A stop bit indicates the end of each character. Set to 1 bit or 2 bits.

### Handshake

1) When sending data from the instrument
   1. Make ER line and RS line active "H". However, in the instrument, RS line is always "H".
   2. Check that CS line is active "H".
   3. Send the data.
   4. Make ER line "L" after sending the data.
2) When the instrument receiving data
   1. Make ER line active "H".
   2. Receive the data.
   3. Make ER line "L" after receiving the data.

The above operations are automatically executed by RS-232-C unit.

**Error Display**

When the instrument receives data, error display will be given if data is incorrect.

- Parity Error
  When a parity bit is set, this will be displayed if the calculated value of parity bit for received data and the actual value received do not match.

- Framing Error
  This will be displayed if the data which does not match the set character frame is received.

**Echo-back Process**

When sending data from external equipment to the instrument. The instrument sends the same data as the received one to the external equipment as echo-back. Send the next data to the instrument. When no error occurs if the original data sent by the external equipment and the data echoed back are compared.

If echo-back is not received and the next data is sent, that is regarded as malfunction. Perform echo-back process character by character.

However, the data sent from the instrument do not demand echo-back process for the external equipment.

## 5-2 SETTING OF SWITCHES

Set baud rate, character length, parity enable, parity sense and stop bit length by switch 1 and delimiter by switch 2 of RS-232-C unit DS-503.

### 5-2-1 Setting of Switch 1

**Baud Rate**

Set baud rate by switches of 3 bit B3 to B1.

| Baud Rate (BPS) | B3 | B2 | B1 |
|---|---|---|---|
| 110 | 0 | 0 | 0 |
| 300 | 0 | 0 | 1 |
| 600 | 0 | 1 | 0 |
| 1200 | 0 | 1 | 1 |
| 2400 | 1 | 0 | 0 |
| 4800 | 1 | 0 | 1 |
| 9600 | 1 | 1 | 0 |
| 19200 | 1 | 1 | 1 |

**Character Length**

Set character length by switch C.

| Character Length (Bit) | C |
|---|---|
| 7 | 0 |
| 8 | 1 |

**Parity Enable**

Set parity enable by switch P.

| Parity | P |
|---|---|
| Disable | 0 |
| Enable | 1 |

**Parity Sense**

Set parity sense by switch OE.

| Parity | OE |
|---|---|
| Odd | 0 |
| Even | 1 |

**Stop Bit**

Set stop bit sence by switch S.

| Stop Bit | S |
|---|---|
| 1 | 0 |
| 2 | 1 |

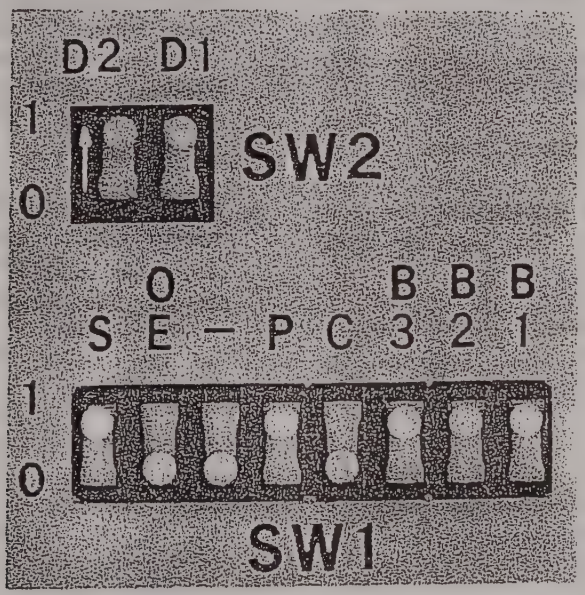
### 5-2-2 Setting of Switch 2 (Delimiter)

Set the type of delimiter in data I/O by D1 and D2.

| D2 | D1 | Delimiter |
|---|---|---|
| 0 | 0 | LF |
| 0 | 1 | LF |
| 1 | 0 | CR |
| 1 | 1 | CR LF |

LF : Line Feed
CR : Carriage Return

Figure 5-2. Sample switch setting




Baud Rate (B3 to B1)
Set to 19,200 BPS.

Character Length (C)
Set to 7 bits.

Parity Enable (P)
Set to Enable.

Parity Sense (OE)
Set to Odd.

Stop Bit (S)
Set to 2.

Delimiter
Set to CR LF.

## 5-3 FUNCTION

### 5-3-1 Outline

Remote operation functions are classified into the following:

a. Data transmission
   (a) Data Read-out
   Information on panel setting can be outputted collectively. The waveform data can be outputted.
   (b) Data Writing
   Panel setting information can be inputted collectively. The waveform data can be inputted in special regions.

b. Panel operations
   The panel operations can be done separately or collectively. Information on panel setting is outputted separately or collectively.

c. Status Output
   (a) Unlocking of panel keys
   (b) Locking of panel keys

### 5-3-2 Data Transmission

a. This function are classified into the following four kinds:
   1. Collective read-out of SET-UP data (panel setting information)
   2. Read-out of displayed waveform data
   3. Collective writing of SET-UP data
   4. Writing of displayed waveform data

b. The transferred contents to be the object of transfer are:
   SET-UP data: Same as individual operations in "4-3-3 Panel Operations".
   Displayed waveform data: Waveform data (main information), waveform auxiliary information

c. Collective read-out and writing of SET-UP data
   By reading out and storing several kinds of contents of manual setting by using collective read-out, necessary settings are easily realized without considering combination of individual operations.
   However, contents of collective read-out are internal codes (table) and basically not open to the users.

d. Number of data for waveform data
   CAPTURE memory captures 2048 data in any sweep range and transfers these to external device. In the range slower than 10 µS/div (5 µS/div in *Norm mode, 1 channel operation), screen and data length may match but in the range faster than 5 S/div (2 µS/div in *Norm mode, 1 channel operation), they may not match. For example, in 5 µS/div, the first 1024 data may correspond with the screen. In other words, in the range faster than 10 µS/div (in the one faster than '5 µS/div for the *1 Norm mode, 1 channel operation), sampling is always mode in 20 MHz clock (40 MHz clock for *Norm mode), 2048 data are captured and they are transmitted to external devices.
   *1 Norm mode: All the modes except for equivalent sampling (EQU - SAMPLING) mode.

e. Waveform auxiliary information
   The waveform auxiliary information is used in the following cases.
   1. When DS-6121 is connected to other equipments made by Iwatsu (SM-2700, etc.):
      These external equipments will use the waveform auxiliary information for processing.
   2. When the user wants to know the sampling block and vertical axis sensitivity of the waveform data:
      The sampling block or vertical axis sensitivity cannot be read out from SET-UP data. As mentioned before, this is because SET-UP data are external codes and not open to users.

The contents transmitted and their order are as shown in the following table.

| Order | Contents | Format |
|---|---|---|
| 1 | Number of waveform auxiliary information | AA ) 6 ) |
| 2 | Type of binary data | AB ) 2 ) |
| 3 | Data of length | AC ) 2 ) |
| 4 | Δx | AD ) 2.5E-6 ) |
| 5 | Y-FULL SCALE | AE ) 0.1024 ) |
| 6 | DELAY value | AF ) 0 ) |

Two alphabet letters: Identification code
) : Delimiter

**Comment**

1. Number of waveform auxiliary information
   For DS-6121, they are six and the number is fixed.
2. Type of binary data
   Binary data of waveform data (main information).
   0 : Binary transmit mode ineffective (ASCII)
   2 : 2 bytes/1 data
3. Data length
   The length of waveform data.rm data.
   1 : 1024
   2 : 2048
4. Δx
   This is a sampling clock cycle when the waveform is captured.
   The display is with exponential format and the unit is [sec.].
   Example: 2.5E-6 → Sampling cycle of 2.5 μS (Equivalent to 0.5 mS/div)
5. Y-FULL SCALE
   This is the full-scale value of vertical (Y) axis.
   The unit for this value is volt (V).
   Example: 0.1024 → 0.1024V full-scale (equivalent to 10 mV/div)

**Example of reading out of waveform auxiliary information**

Example: Reading out of waveform auxiliary information for CH 1
JX M10, 7

You cannot write waveform auxiliary information.
In other words, IX M10, 7 is impossible.

## 5-3-3 Panel Operations

Individual panel operations can be performed. The operation procedure is the same as the manual operation procedure. The lamps (LEDs) on the panel in the individual operation mode operate in the same way as manual operation.

**a. The following individual operations can be performed:**

Measuring condition setting
Display
Output
Processing

**b. Restrictions**

The following are excepted from individual operations:
Power ON/OFF
A INTENSITY
CHARACTER INTENSITY
ENHANCE
BEAM FIND
FOCUS
ASTIG
SCALE
TRACE ROTATION

**Caution**

*Collective setting (writting) or read-out of panel operations can be performed by following the item 4-3-2.*

## 5-4 DETAILS OF RS-232-C COMMANDS

### 5-4-1 Waveform Data Read Command

**Function:** To read data from files to the RS-232-C.
The data read out by this command are:
Setup data
Waveform data
Auxiliary information of waveform data

**Format**

**Parameters**

a. File
- Input buffer memory file M10, M11
- Current setup file S

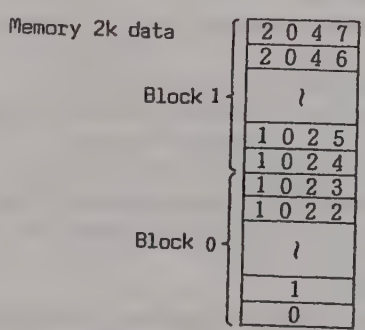
b. Format
- Data record format for data transfer
- Set value

| Format | Code | Data Expression | No. of Bytes for a String | Record Discriminator |
|---|---|---|---|---|
| 1 | ASCII | Integer | 8 bytes max. | LF, CR or CR LF |
| 7 | ASCII | Combination | Variable | LF, CR or CR LF |

<Note> Combination in the data expression column means a combination of an integer, real number, floating decimal point, and alphanumerics.

c. Size
Parameter that specifies the size of main information to be read out from a file in units 1k words
Set values: 1 or 2 1: 1k words
2: 2k words

d. Block
Transfer start block number
Parameter that specifies a file block number to start reading main information
. Set value 0 or 1
<Note> If block 1 is specified, the preceding parameter's <size> will always be 1.
Block size: 1 word
Block numbers 0 and 1 to be assigned every kilo-bytes, starting with the smallest address number.



**Caution**

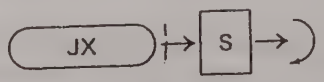
*The following three combinations of size and block are allowed.*

| *Size* | *Block* |
|---|---|
| *1* | *0* |
| *1* | *1* |
| *2* | *0* |

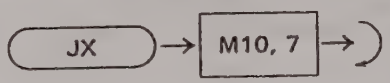
**JX commands**

The following seven types are allowed concerning "JX" command.

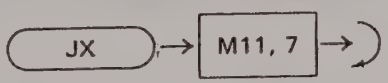
(1) Current setup internal code is transferred.



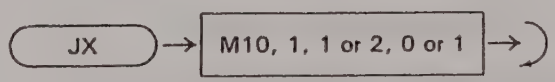

(2) Auxiliary information on the data stored in buffer memory 1 is sent. Format 7 is specified.



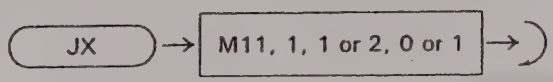

(3) Auxiliary information on the data stored in buffer memory 2 is sent. Format 7 is specified.




(4) The data stored in buffer memory 1 is transferred in ASCII code.



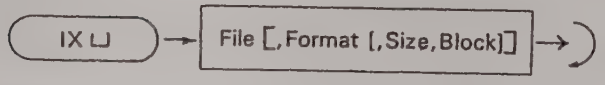

(5) The data stored in buffer memory 2 is transferred in ASCII code.



## 5-4-2 Waveform Data Write Command

**Function:** To write data from the GP-IB to files.
The data written by this command are:
Setup data
Waveform data

**Format**




**Parameters**

a. File
- Input buffer memory file M10 (CH 1), M11 (CH 2)
- Current setup file S

b. Format
- Data record format for data transfer
- Set value

| <Format> | Code | Data Expression | No. of Bytes for a String | Record Discriminator |
|---|---|---|---|---|
| 1 | ASCII | Integer | 8 bytes max. | LF, CR or CR LF |
| 7 | ASCII | Combination | Variable | LF, CR or CR LF |

<Note> Combination in the data expression column means a combination of an integer, reel number, floating decimal point, and alphanumerics.

c. Size
Parameter that specifies the size of main information to be read out from a file in units 1k words
Set values: 1 or 2 1: 1k words
2: 2k words

d. Block
Transfer start block number
Parameter that specifies a file block number to start reading main information
. Set value 0 or 1
<Note> If block 1 is specified, the preceding parameter's <size> will always be 1.

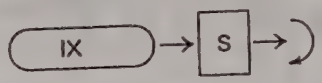
**Caution**

*No IX for auxiliary information.*

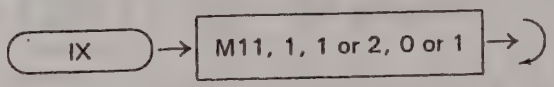
**IX commands**

The following five types are allowed concerning "IX" command.

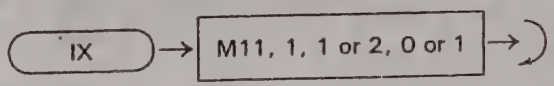
(1) Current setup internal code is transferred.



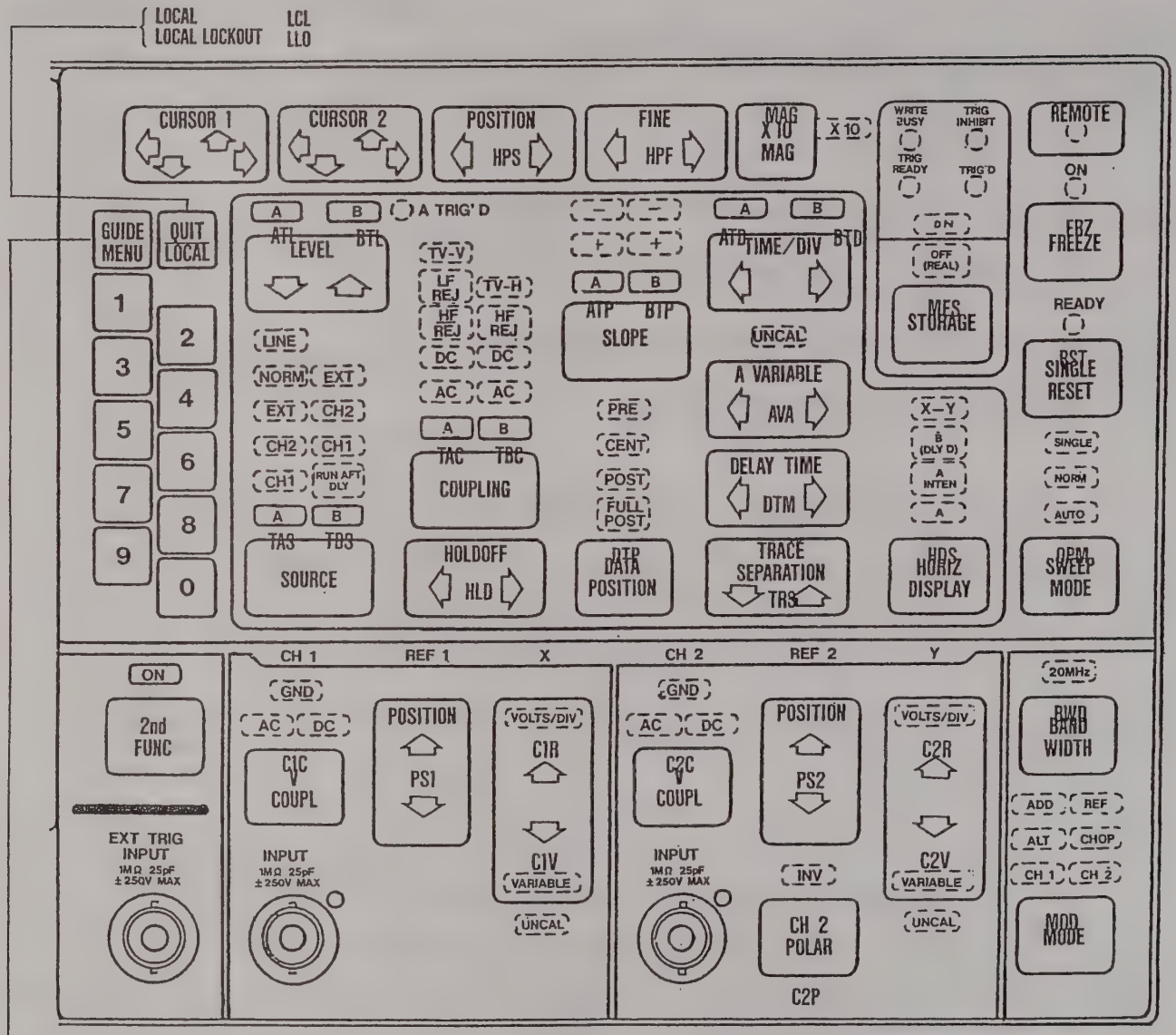

(2) The data stored in buffer memory 1 is transferred in ASCII code.




(3) The data stored in buffer memory 2 is transferred in ASCII code.



## Corresponding List (panel key to RS-232-C command)




<Note> RS-232-C commands are shown in red.

| | |
|---|---|
| Cursor Measurement | CUR |
| SETUP RECALL/SAVE | STU |
| WAVEFORM RECALL | WFM 1 |
| SAVE | WFM 2 |
| MOVE | WFM 3 |
| CURVE INTERPOLATION | IPL |
| CALCULATION | CAL |
| GO/NO JUDGEMENT | |
| a. Cursor-Cursor | YNC |
| b. Waveform-Cursor | YNW |
| AVERAGING | AVR |
| EQU-SAMPLING | EQS |

### 5-4-3 Individual Panel Operations

#### 5-4-3-1 Operations other than Remote/Local

Refer to 4-4-3 Individual Panel Operations (on Pages 4-17 to 4-25).

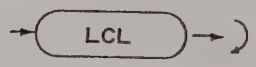
#### 5-4-3-2 Remote/Local

**(39) Local**

**Function**

When this command is received, operations through panel keys are enabled even in the local lockout condition.

**Format**

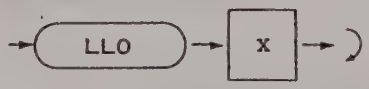



**(40) Local Lockout**

**Function**

When this command is received on Remote, changing of Remote/Local by [OUT LOCAL] key is disabled.

**Format**




**Parameter**

| X | On or Off |
|---|---|
| 0 | OFF |
| 1 | ON |

## 5-5 OPERATION

Connection of the DS-6121 with RS-232-C and the external controller and their operation are as follows.

1. Set baud rate, character length, parity enable, parity sense and stop bit by Switch 1 and delimiter by Switch 2.
2. Insert RS-232-C unit • DS-503 in the hole on the rear panel.
3. Connect RS-232-C multiconnector on DS-503 to an external controller (personal computer, etc.) by a cable.
4. Turn the power switch of the external controller ON.
5. Turn the power switch of DS-6121 ON.

<Note> When connected to a plotter, FRAMING ERROR or OVERRUN ERROR will be displayed on CRT if the plotter is turned ON/OFF while the DS-6121 is turned ON. This is not malfunction.

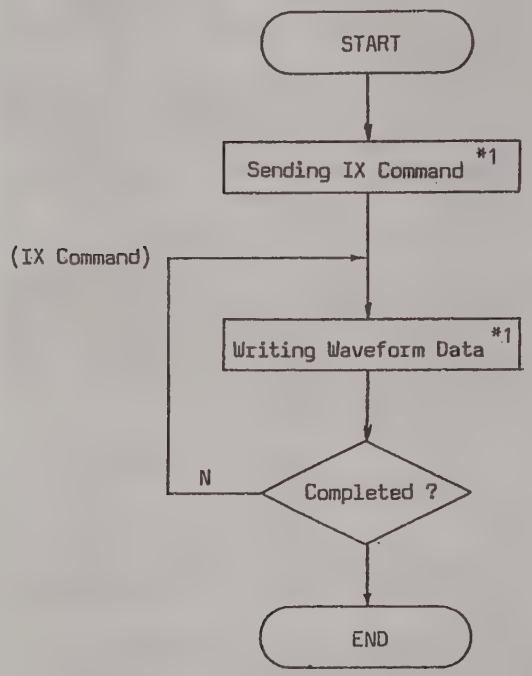
**Caution**

- *When changing the switch setting of RS-232-C, turn the power switch OFF, reset and turn it ON.*
- *When changing connection of RS-232-C connector and the external equipment and when mounting or dismounting of RS-232-C unit, check if the power switches of DS-6121 and the external equipment are turned OFF before doing so.*

## 5-6 PROGRAM FLOW OF THE DS-6121 BY THE CONTROLLER

Described below is the standard procedures for controling the DS-6121 via RS-232-C interface.

**Writing Waveform Data to DS-6121**

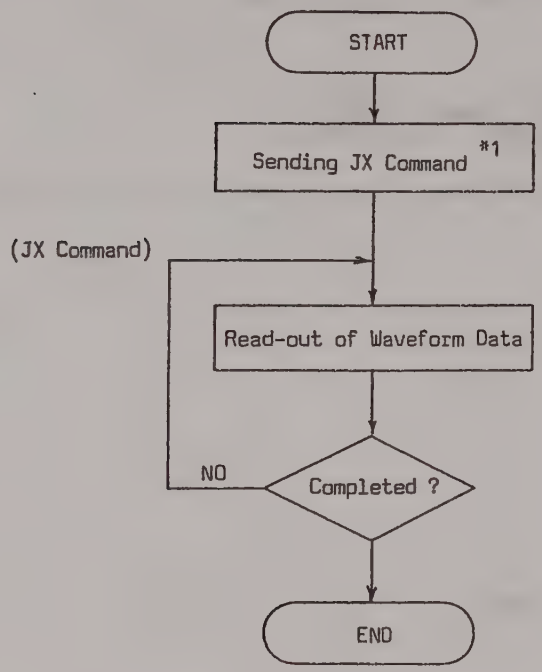



Remote status
Controller → DS-6121
DS-6121 → Controller (Echo-Back)

Controller → DS-6121
DS-6121 → Controller (Echo-Back)

*1 Reform echo-back process character by character.

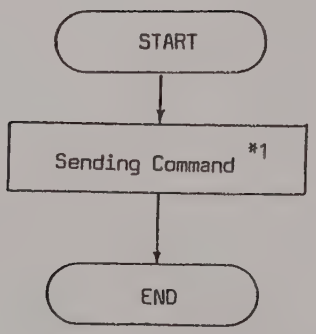
**Read-out of Waveform Data from DS-6121**




Remote status
Controller → DS-6121
DS-6121 → Controller (Echo Back)

DS-6121 → Controller

**One Command Processing**



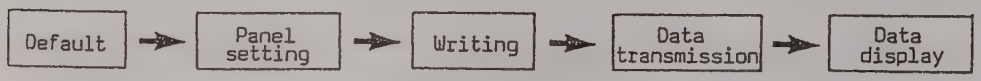

Remote status
Controller → DS-6121
DS-6121 → Controller (Echo-Back)

*1 Reform echo-back process character by character.

## 5-7 SAMPLE PROGRAM

Describes two sample programs that use the PC-9801 and HP-216 as external controller.

**Overall Operations**




**Caution**

**Switches Setting of PC-9801**

*When using PC-9801, set the switches as follows:*

- *Memory switches*

| | | |
|---|---|---|
| *SW1* | *Stop bit* | *Optional* |
| | *Parity enable* | |
| | *Parity sense* | |
| | *Full dual* | *Fixed* |
| | *X parameter disable* | |
| *SW2* | *Baud rate* | *Optional* |
| | *S parameter disable* | *Fixed* |
| | *Return + Line feed at CR LF reception* | |

- *DIP switches on rear panel*

| | |
|---|---|
| *SW1* | *Internal trigger* |

```
10 '
20 '
30 '
40 '
50 CONSOLE 0,25,0,1
60 CLS 3
70 '
100 DIM CH1DATA%(2047),CH2DATA%(2047),CH1AUX$(11),CH2AUX$(11)
110 '
120 OPEN "COM:E83NN" AS #1
130 '
200 P$="STU 1,7"
210 GOSUB *SUB
220 GOSUB *CH1SET
230 GOSUB *CH2SET
240 GOSUB *TRGSET
250 GOSUB *TIMESET
260 GOSUB *STRSET
270 GOSUB *WRTSUB
280 GOSUB *AUXRD
290 GOSUB *CH1READ
300 GOSUB *CH2READ
310 GOSUB *WAVEDISP
320 CLOSE
330 STOP
400 '
410 *CH1READ
420     P$="JX M10,1,2,0"
430     GOSUB *SUB
440     FOR NUMB%=0 TO 2047
450       LINE INPUT #1,CH1DATA$
455       CH1DATA%(NUMB%)=VAL(CH1DATA$)
460     NEXT NUMB%
470     RETURN
500 '
510 *CH2READ
520     P$="JX M11,1,2,0"
530     GOSUB *SUB
540     FOR NUMB%=0 TO 2047
550       LINE INPUT #1,CH2DATA$
555       CH2DATA%(NUMB%)=VAL(CH2DATA$)
560     NEXT NUMB%
570     RETURN
600 '
610 *CH1SET
620     P$="C1R 6"
630     GOSUB *SUB
640     P$="C1C 2"
650     GOSUB *SUB
660     P$="PS1 0"
670     GOSUB *SUB
680     RETURN
```

**Comment**

120 Sets parity enable, data length and stop bit.

| | |
|---|---|
| Parity | Eanble (Even) |
| Data length | 8 bits |
| Stop bit | 2 bits |

200 and 210 Recall DEFAULT setting by using SET RECALL/SAVE.

400 to 470 CH1 READ
2 kW data which is written from CH 1 of the instrument is transmitted to an array declared by Ch 1 data of the controller.

500 to 570 CH2 READ
2 kW data which is written from CH 2 of the instrument is transmitted to an array declared by Ch 2 data of the controller.

600 to 680 CH1 SET
Settings related to CH 1 amplifier.

| | |
|---|---|
| VOLTS/DIV | 50 mV/div |
| Coupling | DC |
| Position | Midrange |

```
700 '
710 *CH2SET
720     P$="C2R 8"
730     GOSUB *SUB
740     P$="C2C 2"
750     GOSUB *SUB
760     P$="PS2 0"
770     GOSUB *SUB
780     P$="C2P 1"
790     GOSUB *SUB
800     RETURN
900 '
910 *TRGSET
920     P$="TAS 2"
930     GOSUB *SUB
940     P$="ATP 1"
950     GOSUB *SUB
960     P$="ATL 10"
970     GOSUB *SUB
980     RETURN
1000 '
1010 *TIMESET
1020    P$="ATD 16"
1030    GOSUB *SUB
1040    RETURN
1050 '
1060 *STRSET
1070    P$="OPM 3"
1080    GOSUB *SUB
1090    P$="MES 1"
1100    GOSUB *SUB
1110    P$="DTP 2"
1120    GOSUB *SUB
1130    RETURN
1150 '
1160 *WRTSUB
1170    P$="RST"
1180    GOSUB *SUB
1185    FOR I%=0 TO 1000 : NEXT I%
1190    RETURN
1250 '
1260 *AUXRD
1270    P$="JX M10.7"
1280    GOSUB *SUB
1290    FOR NUMB%=0 TO 11
1300      LINE INPUT #1,CH1AUX$(NUMB%)
1310    NEXT NUMB%
1320    P$="JX M11.7"
1330    GOSUB *SUB
1340    FOR NUMB%=0 TO 11
1350      LINE INPUT #1,CH2AUX$(NUMB%)
1360    NEXT NUMB%
1370    RETURN
```

**Comment**

700 to 800 CH2 SET

Settings related to CH 2 amplifier.

| | |
|---|---|
| VOLTS/DIV | 0.2 V/div |
| Coupling | DC |
| Position | Midrange |
| Polarity | INVERT |

900 to 980 TRG SET

Settings realted to trigger.

| | |
|---|---|
| A trigger source | CH 2 |
| A trigger slope | - |
| A trigger level | 10% |

1000 to 1040 TIME SET

Settings related to time axis.

| | |
|---|---|
| A TIME/div | 0.1 ms/div |

1050 to 1130 Strset

Changes the instrument the storage mode, sets DATA POSITION to CENT and SWEEP MODE to single.

1150 to 1190 WRTSUB

Sets the instrument to single reset. This instruction makes this unit a trigger wait state. When triggered, writing is started.

1250 to 1370 AUXRD

Reads out auxiliary information.

```
1400 '
1410 *WAVEDISP
1420    SCREEN 3.0
1430    CLS 3
1440    GOSUB *MEASUR
1450    GOSUB *PRNAUX
1460    FOR X%=0 TO 2047 STEP 4
1470      CH1Y%=(CH1DATA%(X%)/256-129)*(-1)
1480      PSET ((X%+1)/4+62.CH1Y%),2
1490    NEXT X%
1500    FOR X%=0 TO 2047 STEP 4
1510      CH2Y%=(CH2DATA%(X%)/256-129)*(-1)
1520      PSET ((X%+1)/4+62.CH2Y%),1
1530    NEXT X%
1540    RETURN
1600 '
1610 *MEASUR
1620    LINE(63.0)-(575.257),7.B
1630    LINE(63,128)-(575.128),7
1640 '
1650    FOR I%=115 TO 523 STEP 51 : LINE(I%.0)-(I%.9),7     : NEXT I%
1660    FOR I%=115 TO 523 STEP 51 : LINE(I%.118)-(I%.138),7 : NEXT I%
1670    FOR I%=115 TO 523 STEP 51 : LINE(I%,257)-(I%.247),7 : NEXT I%
1680 '
1690    FOR I%=28 TO 231 STEP 25 : LINE(63,I%)-(73.I%),7   : NEXT I%
1700    FOR I%=28 TO 231 STEP 25 : LINE(575,I%)-(565.I%),7 : NEXT I%
1710    RETURN
1800 '
1810 *PRNAUX
1820    LOCATE 10,16 : PRINT "**** AUXILIARY INFORMATION ****"
1830    PRINT "CH1 : "; : FOR NUMB%=0 TO 11 : PRINT CH1AUX$(NUMB%)+" ": : NEXT N
UMB%
1840    LOCATE 0.19
1850    PRINT "CH2 : "; : FOR NUMB%=0 TO 11 : PRINT CH2AUX$(NUMB%)+" ": : NEXT N
UMB%
1860    COLOR@(0.17)-(79.18),2
1870    COLOR@(0.19)-(79.20),1
1880    RETURN
1900 '
1910 *SUB
1920    D$=""
1930    CNUMB%=LEN(P$)
1940    FOR I%=1 TO CNUMB%+2
1950      IF I%=CNUMB%+1 THEN PRINT #1,CHR$(13);
1960      IF I%=CNUMB%+2 THEN PRINT #1.CHR$(10);
1970      IF I%<=CNUMB%  THEN PRINT #1.MID$(P$.I%.1);
1980      D$=D$+INPUT$(1.#1)
1990    NEXT I%
2000    IF P$<>LEFT$(D$.CNUMB%) THEN GOTO *SUB
2010    RETURN
2100 '
2110 END
```

**Comment**

1400 to 1540 WAVEDISP

Waveforms are displayed based on the data stored in the arrays Ch 1 data and Ch 2 data.

1950 to 1960 Sets delimiter
Delimiter CR LF

```
10     !
20     !
30     !
40     !
50     GRAPHICS OFF
100    ASSIGN @Rs232c TO 9
110    DIM String1$[16384] BUFFER
115    DIM String2$[16384] BUFFER
120    INTEGER Ch1data(2047)
130    INTEGER Ch2data(2047)
140    !
150    CONTROL 9,1;0
160    CONTROL 9,3;9600
170    CONTROL 9,4;31
175    CONTROL 9,5;0
180    !
190    ON ERROR GOTO Error
200    !
210    P$="STU 1,7"
220    GOSUB Subr
240    GOSUB Ch1set
250    GOSUB Ch2set
260    GOSUB Trgset
270    GOSUB Timeset
280    GOSUB Strset
290    GOSUB Wrtsub
300    GOSUB Award
310    GOSUB Ch1read
320    GOSUB Ch2read
330    GOSUB Wavedisp
340    STOP
400    !
410 Ch1read:    !
420           P$="JX M10,1,2,0"
430           GOSUB Subr
440           ASSIGN @Buff TO BUFFER String1$
445           TRANSFER @Rs232c TO @Buff
450           ASSIGN @Buff TO *
460           FOR I=1 TO 16384 STEP 8
465             FOR J=0 TO 7
470               IF String1$[I+J;1]=CHR$(32) THEN String1$[I+J;1]=CHR$(48)
475             NEXT J
480             Ch1data(I DIV 8)=VAL(String1$[I;6])
485           NEXT I
490           RETURN
```

**Comment**

160 Sets baud rate
Baud rate 9600 BPS
170 Sets parity enable, data length and stop bit.
Parity Enable (Even)
Data length 8 bits
Stop bit 2 bits
210 and 220 Recall DEFAULT setting by using SET RECALL/SAVE

400 to 470 Ch 1 read
2 kW data which is written from CH 1 of the instrument is transmitted to an array declared by Ch 1 data of the controller.

```
500   !
510 Ch2read:    !
520           P$="JX MII,1,2,0"
530           GOSUB Subr
540           ASSIGN @Buff TO BUFFER String2$
545           TRANSFER @Rs232c TO @Buff
550           ASSIGN @Buff TO *
560           FOR I=1 TO 16384 STEP 8
565             FOR J=0 TO 7
570               IF String2$[I+J;1]=CHR$(32) THEN String2$[I+J;1]=CHR$(48)
575             NEXT J
580             Ch2data(I DIV 8)=VAL(String2$[I;6])
585           NEXT I
590             RETURN
600   !
610 Chiset:   !
620           P$="CIR 6"
630           GOSUB Subr
650           P$="CIC 2"
660           GOSUB Subr
680           P$="PSI 0"
690           GOSUB Subr
710           RETURN
800   !
810 Ch2set:   !
830           P$="C2R 8"
830           GOSUB Subr
850           P$="C2C 2"
860           GOSUB Subr
880           P$="PS2 0"
890           GOSUB Subr
910           P$="C2P 1"
920           GOSUB Subr
940           RETURN
1000  !
1010 Trgsel:  !
1020          P$="TAS 2"
1030          GOSUB Subr
1050          P$="ATP 1"
1060          GOSUB Subr
1080          P$="ATL 10"
1090          GOSUB Subr
1110          RETURN
1200  !
1210 Timeset: !
1220          P$="ATD 16"
1230          GOSUB Subr
1250          RETURN
```

**Comment**

500 to 570 Ch 1 read

2 kW data which is written from CH 2 of the instrument is transmitted to an array declared by Ch 2 data of the controller.

600 to 710 Ch 1 set

Settings related to CH 1 amplifier.

| | |
|---|---|
| Range | 50 mV/div |
| Coupling | DC |
| Position | CENTER |

800 to 940 Ch 2 set

Settings related to CH 2 amplifier.

| | |
|---|---|
| VOLTS/DIV | 0.2 V/div |
| Coupling | DC |
| Position | CENTER |
| Polarity | INVERT |

1000 to 1110 Trg set

Settings realted to trigger.

| | |
|---|---|
| A trigger source | CH 2 |
| A trigger slope | - |
| A trigger level | 10% |

1200 to 1250 Time set

Settings related to time axis.

| | |
|---|---|
| A TIME/div | 0.1 ms/div |

```
1300  !
1310 Strset: !
1320         P$="OPN 3"
1330         GOSUB Subr
1350         P$="MES 1"
1360         GOSUB Subr
1380         P$="DIP 2"
1390         GOSUB Subr
1410         RETURN
1500  !
1510 Wrtsub: !
1520         P$="RST"
1530         GOSUB Subr
1560         WAIT 1
1570         RETURN
1600  !
1610 Auxrd: !
1620         P$="JX M10,7"
1630         GOSUB Subr
1650         FOR I=0 TO 11
1653           J=0
1657           J=J+1
1660           ENTER @R=232c USING "#,A";Ch1aux$[J;1]
1665           IF Ch1aux$[J;1]<>CHR$(10) THEN GOTO 1657
1670             PRINT Ch1aux$[1;J-2]
1680         NEXT I
1690         WAIT .5
1700         P$="JX M11,7"
1710         GOSUB Subr
1730         FOR I=0 TO 11
1733           J=0
1737           J=J+1
1740           ENTER @R=232c USING "#,A";Ch2aux$[J;1]
1745           IF Ch2aux$[J;1]<>CHR$(10) THEN GOTO 1737
1750             PRINT Ch2aux$[1;J-2]
1760         NEXT I
1770         RETURN
1800 Wavedisp: !
1810         GRAPHICS ON
1820         WINDOW 0,2047,-256,256
1830         VIEWPORT 0,400,0,200
1840         MOVE 0,0
1850         FOR I=0 TO 2047
1860           Ch1d=Ch1data(I)/256+128
1870           PLOT I,Ch1d
1880         NEXT I
1890         MOVE 0,0
1900         FOR I=0 TO 2047
1910           Ch2d=Ch2data(I)/256*(-1)-128
1920           PLOT I,Ch2d
1930         NEXT I
1940         RETURN
```

Comment

1300 to 1410 Strset

Changes this unit to storage mode and sets the operation mode to single.

1500 to 1570 Wrtsub

Sets single reset to the instrument. This instruction makes this unit a trigger wait state. When triggered, writing is started and finished.

1600 to 1770 Auxrd

Reads out auxiliary information.

1800 to 1940 Wavedisp

Waveforms are displayed based on the data stored in the arrays Ch 1 data and Ch 2 data.

```
2000  !
2010 Error: !
2020        IF ERRN<>167 THEN PRINT "error <>167"
2030        STATUS 9,10;Uart
2040        IF BIT(Uart,1) THEN PRINT "Overrun error"
2050        IF BIT(Uart,2) THEN PRINT "Parity error"
2060        IF BIT(Uart,3) THEN PRINT "Framing error"
2070        IF BIT(Uart,4) THEN PRINT "BREAK received"
2080        IF BIT(Uart,5) THEN PRINT "T.H.Register empty"
2090        IF BIT(Uart,6) THEN PRINT "T.S.Register empty"
2100        STOP
2300  !
2310 Subr:  !
2315        D$=""
2320        Cnumb=LEN(P$)
2325        FOR I=1 TO Cnumb+2
2330          IF I=Cnumb+2 THEN OUTPUT @Rs232c;CHR$(10);
2360          IF I=Cnumb+1 THEN OUTPUT @Rs232c;CHR$(13);
2390          IF I<=Cnumb THEN OUTPUT @Rs232c;P$[I;1];
2430            ENTER @Rs232c USING "#,A";D$[I;1]
2470        NEXT I
2480        IF P$<>D$[1;Cnumb] THEN GOTO 2315
2490        RETURN
2500  END
```

Comment

2330 to 2360 Sets delimiter
Delimiter CR LF

MEMO

1. Available TIME/DIV in Each Function

| TIME/DIV / Function | EXT | 0.2s | 0.5ms | 2μs |
|---|---|---|---|---|
| STORAGE OFF (REAL) | | 0.1s | | |
| STORAGE OFF (ROLL) | 10s | 0.2s | | |
| STORAGE ON | | | | |
| EQU-SAMPLING 1 channel | | | | 2μs |
| EQU-SAMPLING 2 channels | | | | 5μs |

2: List of functions which can be selected in combination

The following table shows whether or not a particular F1 MENU item can be selected simultaneously with a particular F2 item.

| F1 \ F2 | 1) MEASUREMENT BY CURSORS | 2) SETUP RECALL/SAVE | 3) WAVEFORM RECALL/SAVE | 4) AVERAGING | 5) EQU-SAMPLING | 6) CURVE INTERPOLATION | 7) +−× | 8) GO/NO GO | 9) WAVEFROM OUT |
|---|---|---|---|---|---|---|---|---|---|
| 1) MEASUREMENT BY CURSORS | | O | O | O | O | O | O | | |
| 2) SETUP RECALL/SAVE | | | | | | | | | |
| 3) WAVEFORM RECALL/SAVE | | | | | | | | | |
| 4) AVERAGING | O | O | O | | O | O | O | O | O |
| 5) EQU-SAMPLING | O | O | O | O | | O | O | O | O |
| 6) CURVE INTERPOLATION | O | O | O | O | O | | O | O | O |
| 7) +−× | O | O | O | O | O | O | | O | O |
| 8) GO/NO GO | | | *1 | O | O | O | O | | |
| 9) WAVEFORM OUT | | | | | | | | | |

O shows that the simultaneous selection is possible.

*1 SAVE can be performed simultaneously but RECALL should be performed with other modes.

3: Note on (OUT/LOCAL) key

- (OUT/LOCAL) key is used for clearing FUNCTION selected from GUIDE MENU.

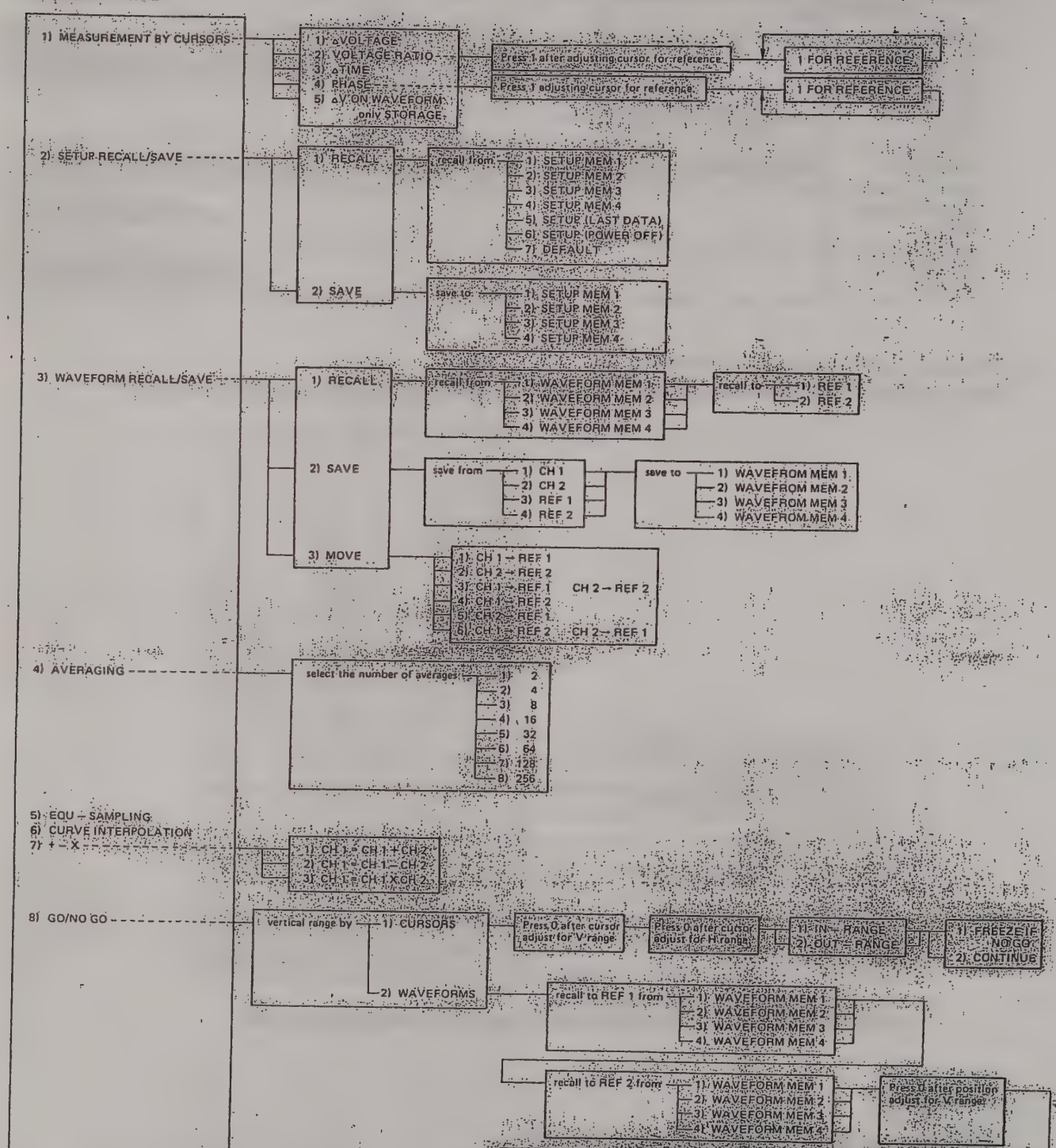
  Selecting multiple FUNCTIONS from GUIDE MENU and pressing (OUT/LOCAL) after completion of operating, all FUNCTIONS is cleared.

  Selecting multiple FUNCTIONS from GUIDE MENU and pressing (OUT/LOCAL) during operating, only one FUNCTION selected last is cleared.

- Clearing a particular FUNCTION find its (OFF) display in GUIDE MENU and press the relevant numerical key with the corresponding function number.

IWATSU ELECTRIC CO., LTD.
YANAGIYA BLDG. 1-10, NIHONBASHI 2-CHOME, CHUO-KU,
TOKYO, 103 JAPAN TEL: TOKYO (271) 5131 FAX: TOKYO (271) 1554
CABLE ADDRESS: TELEPHIWATSU TELEX : J24225: TELEIWA

GUIDE MENU TREE



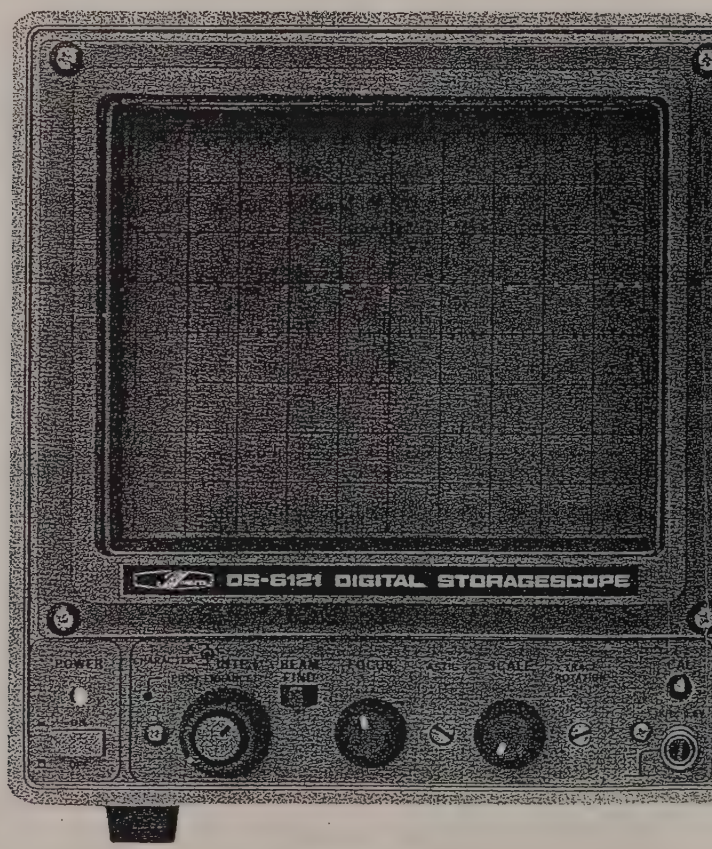
# Section 2 Controls, Connectors and Indicators

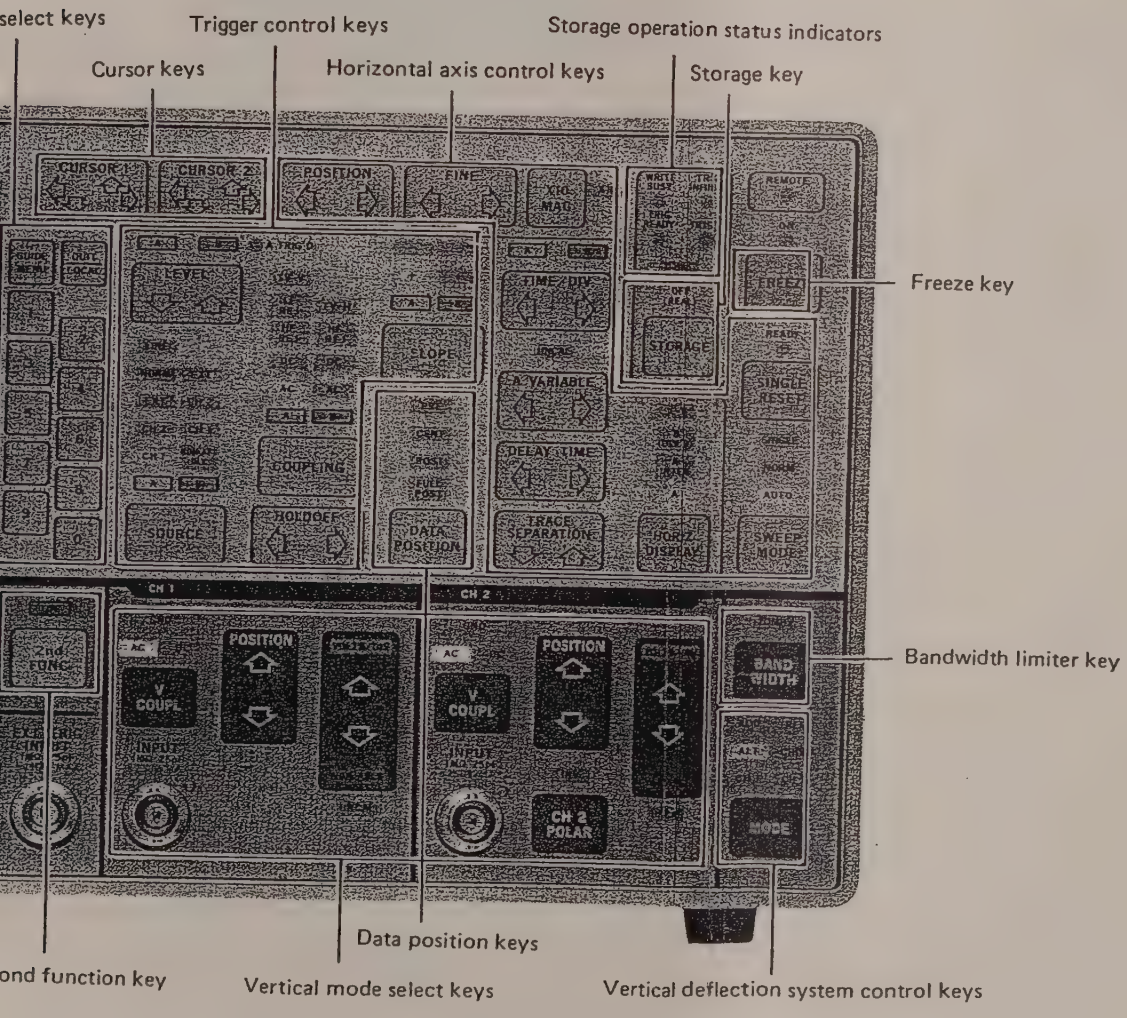
The following descriptions are intended to familiarize the operator with the location and functi
of the instrument's controls, connectors and indicators.

## 2-1 FRONT PANEL

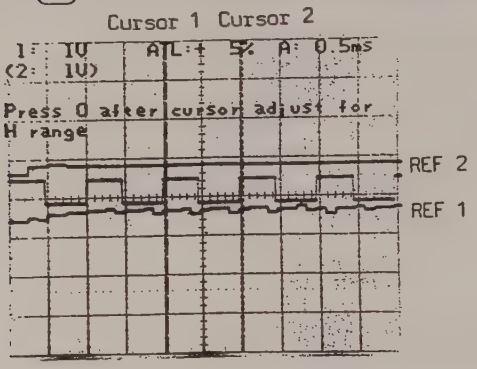
Figure 2-1. Front Panel

Functi




select keys
Trigger control keys
Storage operation status indicators
Cursor keys
Horizontal axis control keys
Storage key
Freeze key
Bandwidth limiter key
Data position keys
ond function key
Vertical mode select keys
Vertical deflection system control keys
CURSOR 1
CURSOR 2
POSITION
FINE
X10 MAG
REMOTE
FREEZE
LEVEL
SLOPE
TIME/DIV
STORAGE
A VARIABLE
SINGLE RESET
COUPLING
DELAY TIME
SOURCE
HOLDOFF
DATA POSITION
TRACE SEPARATION
HORIZ DISPLAY
SWEEP MODE
CH 1
CH 2
2nd FUNC
V COUPL
INPUT
CH 2 POLAR
BAND WIDTH
MODE

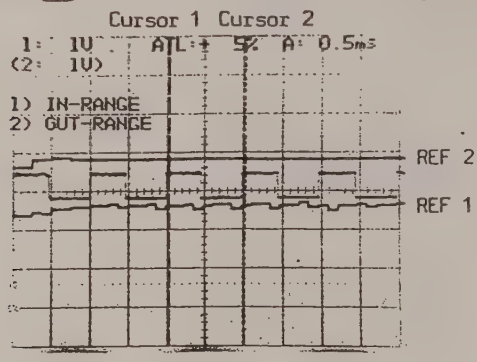
⑨ Press [0], and the following is displayed.




"H. Cursors" Adjustment

⑩ Adjust the horizontal positions of cursors with [CURSOR 1] and [CURSOR 2].

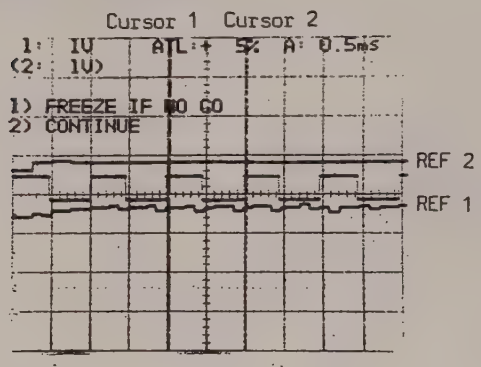
⑪ Press [0]. and the following is displayed.




"IN or OUT RANGE" Selecting

1) IN-RANGE
The range between the two cursors are subject to NO GO operation.
2) OUT-RANGE
The range outside of the two cursors is subject to NO GO operation.

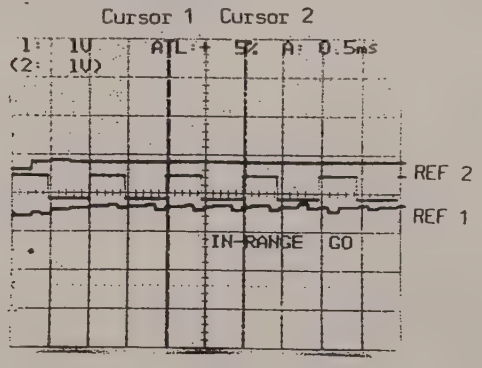
⑫ Press [1] (IN-RANGE is selected), and the following is displayed.



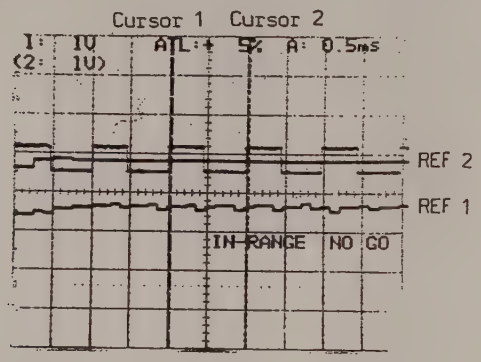

"FREEZE or CONTINUE" Selecting

1) FREEZE IF NO GO
When the range is outside of the cursors (NO GO), FREEZE is effectuated.
2) CONTINUE
Even when the range is outside of two cursors (NO GO), FREEZE is not effectuated.

⑬ Press [1] (FREEZE IF NO GO is selected), the following is displayed.
As the waveform is within the two cursors, the state is "IN-RANGE GO".



When the waveform is in a position as shown in the following figure, it is outside of the two cursors and the state is "IN-RANGE NO GO". As FREEZE IF NO GO was selected, the waveform is frozen.



| Commands | Contents | Parameter (1) |
|---|---|---|
| (1) MES | Measuring mode | 0 : STORAGE OFF<br>1 : STORAGE ON |
| (2) MOD | Vertical mode | 1 : CH 1<br>2 : CH 2<br>3 : ALT<br>4 : CHOP<br>5 : ADD<br>6 : CH 1 & CH 2<br>7 : CH 1 CH 2 & REF |
| (3) C1R<br>C2R | CH 1 VOLTS/DIV<br>CH 2 VOLTS/DIV | 1 : 1 mV<br>2 : 2 mV<br>3 : 5 mV<br>4 : 10 mV<br>5 : 20 mV<br>6 : 50 mV<br>7 : 0.1 V<br>8 : 0.2 V<br>9 : 0.5 V<br>10 : 1 V<br>11 : 2 V<br>12 : 5 V |
| (4) C1V<br>C2V | CH 1 VARIABLE<br>CH 2 VARIABLE | 0 ≦ ~ ≦ 255 |
| (5) C1C<br>C2C | CH 1 COUPLING<br>CH 2 COUPLING | 0 : AC<br>1 : GND<br>2 : DC |
| (6) PS 1<br>PS 2 | CH 1 Vert. POSITION<br>CH 2 Vert. POSITION | −1024 ≦ ~ ≦ +1023 |
| (7) C2P | CH 2 POLARITY | 0 : NORMAL<br>1 : INVERT |
| (8) BWD | BANDWIDTH | 0 : OFF<br>1 : ON (20MHz) |
| (9) HDS | HORIZ DISPLAY | 1 : A<br>2 : A INTEN<br>3 : A INTEN & B (BLY'D)<br>4 : B (BLY'D)<br>5 : X-Y |
| (10) TAS | A TRIGGER SOURCE | 1 : CH 1<br>2 : CH 2<br>3 : EXT<br>4 : NORM |

| Commands | Contents | Parameter (1) | Parameter (2) | Parameter (3) |
|---|---|---|---|---|
| (20) AVA | A VARIABLE | 0 ≦ ~ ≦ 257 | | |
| (21) HLD | HOLDOFF | 0 ≦ ~ ≦ 200 | | |
| (22) TRS | TRACE SEPARATION | 0 ≦ ~ ≦ 255 | | |
| (23) DTM | DELAY TIME | 0.20 ≦ ~ ≦ 10.20 | | |
| (24) DTP | DATA POSITION | 0 : FULL POST<br>1 : POST<br>2 : CENTER<br>3 : PRE | | |
| (25) OPM | OPERATION mode | 1 : AUTO<br>2 : NORM<br>3 : SINGLE | | |
| (26) RST | SINGLE RESET | No parameter | | |
| (27) FRZ | FREEZE | 0: OFF<br>1: ON | | |
| (28) HPS | HORIZONTAL POSITION | −128 ≦ ~ ≦ +127 | | |
| (29) HPF | FINE (HOR. POSITION) | −8 ≦ ~ ≦ +7 | | |
| (30) MAG | MAG X10 | 0 : OFF<br>1 : ON | | |
| (31) CUR | CURSOR measurement | 0 : OFF<br>1 : ΔVOLTS<br>2 : ΔTIME<br>3 : ΔVOLTS ON WAVEFORM | ΔVOLTS<br>−512 ≦ ~ ≦ +511<br>ΔTIME or ΔVOLTS ON WAVEFORM<br>0 ≦ ~ ≦ 2048 | ΔVOLTS<br>−512 ≦ ~ ≦ +511<br>ΔTIME or ΔVOLTS ON WAVEFORM<br>0 ≦ ~ ≦ 2048 |
| (32) STU | SETUP RECALL/SAVE | 1 : RECALL<br>2 : SAVE | 1 : SETUP MEM 1<br>2 : SETUP MEM 2<br>3 : SETUP MEM 3<br>4 : SETUP MEM 4<br>5 : SETUP (LAST DATA)<br>6 : SETUP (POWER OFF)<br>7 : DEFAULT | |
| (33)<br>a. WFM 1 | WAVEFORM RECALL | 1 : WFM MEM 1<br>2 : WFM MEM 2<br>3 : WFM MEM 3<br>4 : WFM MEM 4 | 3 : REF 1<br>4 : REF 2 | |
| b. WFM 2 | WAVEFORM SAVE | 1 : CH 1<br>2 : CH 2<br>3 : REF 1 | 1 : WFM MEM 1<br>2 : WFM MEM 2<br>3 : WFM MEM 3 | |

| | | |
|---|---|---|
| | | 3 : EXT<br>4 : NORM<br>5 : LINE |
| (11) TBS | B TRIGGER SOURCE | 0 : RUN AFTER DELAY<br>1 : CH 1<br>2 : CH 2<br>3 : EXT |
| (12) TAC | A TRIGGER COUPLING | 1 : AC<br>2 : DC<br>3 : HF REJ<br>4 : LF REJ<br>5 : TV-V |
| (13) TBC | B TRIGGER COUPLING | 1 : AC<br>2 : DC<br>3 : HF REJ |
| (14) ATP | A TRIGGER SLOPE | 0 : +<br>1 : – |
| (15) BTP | B TRIGGER SLOPE | 0 : +<br>1 : – |
| (16) ATL | A TRIGGER LEVEL | –100 ≦ ~ ≦ +100 |
| (17) BTL | B TRIGGER LEVEL | –100 ≦ ~ ≦ +100 |
| (18) ATD | A TIME/DIV | 0 : EXT CLOCK<br>1 : 10 s<br>2 : 5 s<br>3 : 2 s<br>4 : 1 s<br>5 : 0.5 s<br>6 : 0.2 s<br>7 : 0.1 s<br>8 : 50 ms<br>9 : 20 ms<br>10 : 10 ms<br>11 : 5 ms<br>12 : 2 ms<br>13 : 1 ms<br>14 : 0.5 ms<br>15 : 0.2 ms<br>16 : 0.1 ms<br>17 : 50 µs<br>18 : 20 µs<br>19 : 10 µs<br>20 : 5 µs<br>21 : 2 µs<br>22 : 1 µs<br>23 : 0.5 µs<br>24 : 0.2 µs<br>25 : 0.1 µs<br>26 : 50 ns<br>27 : 20 ns |
| (19) BTD | B TIME/DIV | 7 : 0.1 s<br>8 : 50 ms<br>9 : 20 ms<br>10 : 10 ms<br>11 : 5 ms<br>12 : 2 ms<br>13 : 1 ms<br>14 : 0.5 ms<br>15 : 0.2 ms<br>16 : 0.1 ms<br>17 : 50 µs<br>18 : 20 µs<br>19 : 10 µs<br>20 : 5 µs<br>21 : 2 µs<br>22 : 1 µs<br>23 : 0.5 µs<br>24 : 0.2 µs<br>25 : 0.1 µs<br>26 : 50 ns<br>27 : 20 ns |

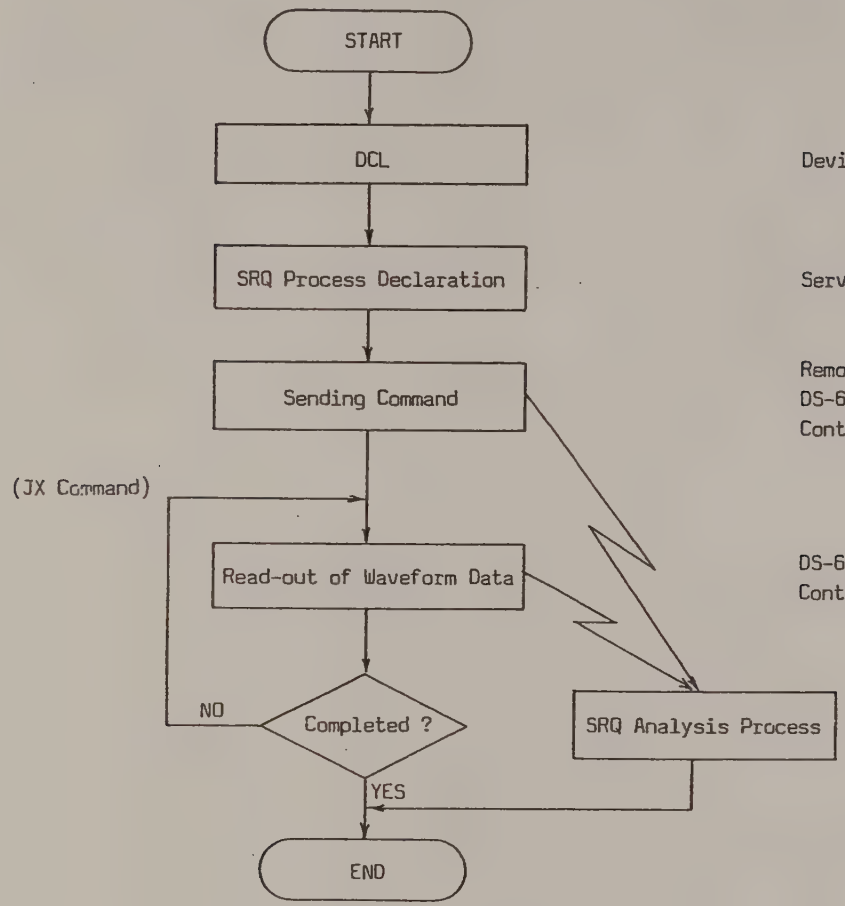
| | | | | |
|---|---|---|---|---|
| b. WFM 2 | WAVEFORM SAVE | 1 : CH 1<br>2 : CH 2<br>3 : REF 1<br>4 : REF 2 | 1 : WFM MEM 1<br>2 : WFM MEM 2<br>3 : WFM MEM 3<br>4 : WFM MEM 4 | |
| c. WFM 3 | WAVEFORM MOVE | 1 : CH 1 → REF 1<br>2 : CH 2 → REF 2<br>3 : CH 1 → REF 1<br>CH 2 → REF 2<br>4 : CH 1 → REF 2<br>5 : CH 2 → REF 1<br>6 : CH 1 → REF 2<br>CH 2 → REF 1 | | |
| (34) IPL | CURVE INTERPOLATION | 0 : OFF<br>1 : ON | | |
| (35) CAL | CALCULATION +, –, X | 0 : OFF<br>1 : ON | 1 : +<br>2 : –<br>3 : X | |

| Commands | Contents | Parameter (1) | Parameter (2, 3) | Parameter (4, 5) |
|---|---|---|---|---|
| (36) a. YNC | GO/NO Cur. to Cur. | 0 : OFF<br>1 : IN-RANGE<br>2 : OUT-RANGE | –512 ≦ ~ ≦ +511 | 0 ≦ ~ ≦ +2047 |

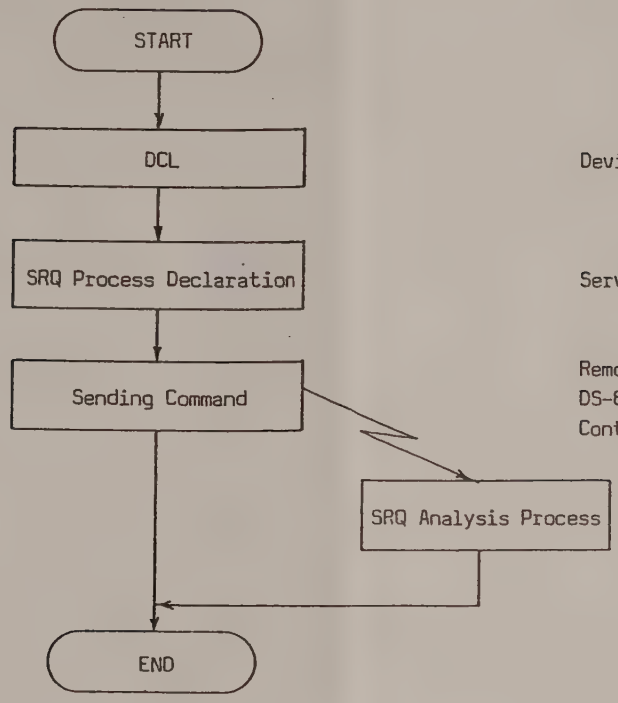
| Commands | Contents | Parameter (1) | Parameter (2, 3) | Parameter (4) |
|---|---|---|---|---|
| b. YNW | GO/NO Cur. to Wave | 0 : OFF<br>1 : IN-RANGE<br>2 : OUT-RANGE | 0 ≦ ~ ≦ 2047 | 1 : WFM MEM 1<br>2 : WFM MEM 2<br>3 : WFM MEM 3<br>4 : WFM MEM 4 |
| | | Parameter (5) | Parameter (6) | Parameter (7) |
| | | –256 ≦ ~ ≦ +255 | 1 : WFM MEM 1<br>2 : WFM MEM 2<br>3 : WFM MEM 3<br>4 : WFM MEM 4 | –256 ≦ ~ ≦ +255 |

| Commands | Contents | Parameter (1) |
|---|---|---|
| (37) AVR | AVERAGING | 0 : OFF<br>1 : 2<br>2 : 4<br>3 : 8<br>4 : 16<br>5 : 32<br>6 : 64<br>7 : 128<br>8 : 256 |
| (38) EQS | EQUIVALENT SAMPLING | 0 : OFF<br>1 : ON |

## Read-out of Waveform Data from DS-6121



**One Command Processing**




Device clear

Service request process declaration

Remote status
DS-6121 : Listener
Controller : Talker

## Commands List

| Commands | Contents | Parameter (1) |
|---|---|---|
| (1) MES | Measuring mode | 0 : STORAGE OFF<br>1 : STORAGE ON |
| (2) MOD | Vertical mode | 1 : CH 1<br>2 : CH 2<br>3 : ALT<br>4 : CHOP<br>5 : ADD<br>6 : CH 1 & CH 2<br>7 : CH 1 CH 2 & REF |
| (3) C1R<br>C2R | CH 1 VOLTS/DIV<br>CH 2 VOLTS/DIV | 1 : 1 mV<br>2 : 2 mV<br>3 : 5 mV<br>4 : 10 mV<br>5 : 20 mV<br>6 : 50 mV<br>7 : 0.1 V<br>8 : 0.2 V<br>9 : 0.5 V<br>10 : 1 V<br>11 : 2 V<br>12 : 5 V |
| (4) C1V<br>C2V | CH 1 VARIABLE<br>CH 2 VARIABLE | 0 ≦ ~ ≦ 255 |
| (5) C1C<br>C2C | CH 1 COUPLING<br>CH 2 COUPLING | 0 : AC<br>1 : GND<br>2 : DC |
| (6) PS 1<br>PS 2 | CH 1 Vert. POSITION<br>CH 2 Vert. POSITION | −1024 ≦ ~ ≦ +1023 |
| (7) C2P | CH 2 POLARITY | 0 : NORMAL<br>1 : INVERT |
| (8) BWD | BANDWIDTH | 0 : OFF<br>1 : ON (20MHz) |
| (9) HDS | HORIZ DISPLAY | 1 : A<br>2 : A INTEN<br>3 : A INTEN & B (BLY'D)<br>4 : B (BLY'D)<br>5 : X-Y |
| (10) TAS | A TRIGGER | 1 : CH 1 |

| Commands | Contents | Parameter (1) | Parameter (2) | Parameter (3) |
|---|---|---|---|---|
| (23) DTM | DELAY TIME | 0.20 ≦ ~ ≦ 10.20 | | |
| (24) DTP | DATA POSITION | 0 : FULL POST<br>1 : POST<br>2 : CENTER<br>3 : PRE | | |
| (25) OPM | OPERATION mode | 1 : AUTO<br>2 : NORM<br>3 : SINGLE | | |
| (26) RST | SINGLE RESET | No parameter | | |
| (27) FRZ | FREEZE | 0: OFF<br>1: ON | | |
| (28) HPS | HORIZONTAL POSITION | −128 ≦ ~ ≦ +127 | | |
| (29) HPF | FINE (HOR. POSITION) | −8 ≦ ~ ≦ +7 | | |
| (30) MAG | MAG X10 | 0 : OFF<br>1 : ON | | |
| (31) CUR | CURSOR measurement | 0 : OFF<br>1 : ΔVOLTS<br>2 : ΔTIME<br>3 : ΔVOLTS ON WAVEFORM | ΔVOLTS<br>−512 ≦ ~ ≦ +511<br>ΔTIME or ΔVOLTS<br>ON WAVEFORM<br>0 ≦ ~ ≦ 2048 | ΔVOLTS<br>−512 ≦ ~ ≦ +511<br>ΔTIME or ΔVOLTS<br>ON WAVEFORM<br>0 ≦ ~ ≦ 2048 |
| (32) STU | SETUP RECALL/SAVE | 1 : RECALL<br>2 : SAVE | 1 : SETUP MEM 1<br>2 : SETUP MEM 2<br>3 : SETUP MEM 3<br>4 : SETUP MEM 4<br>5 : SETUP (LAST DATA)<br>6 : SETUP (POWER OFF)<br>7 : DEFAULT | |
| (33)<br>a. WFM 1 | WAVEFORM RECALL | 1 : WFM MEM 1<br>2 : WFM MEM 2<br>3 : WFM MEM 3<br>4 : WFM MEM 4 | 3 : REF 1<br>4 : REF 2 | |
| b. WFM 2 | WAVEFORM SAVE | 1 : CH 1<br>2 : CH 2<br>3 : REF 1<br>4 : REF 2 | 1 : WFM MEM 1<br>2 : WFM MEM 2<br>3 : WFM MEM 3<br>4 : WFM MEM 4 | |
| c. WFM 3 | WAVEFORM | 1 : CH 1 → REF 1 | | |

| | | |
|---|---|---|
| | | 4 : NORM<br>5 : LINE |
| (11) TBS | B TRIGGER SOURCE | 0 : RUN AFTER DELAY<br>1 : CH 1<br>2 : CH 2<br>3 : EXT |
| (12) TAC | A TRIGGER COUPLING | 1 : AC<br>2 : DC<br>3 : HF REJ<br>4 : LF REJ<br>5 : TV-V |
| (13) TBC | B TRIGGER COUPLING | 1 : AC<br>2 : DC<br>3 : HF REJ |
| (14) ATP | A TRIGGER SLOPE | 0 : +<br>1 : – |
| (15) BTP | B TRIGGER SLOPE | 0 : +<br>1 : – |
| (16) ATL | A TRIGGER LEVEL | $-100 \leqq \sim \leqq +100$ |
| (17) BTL | B TRIGGER LEVEL | $-100 \leqq \sim \leqq +100$ |
| (18) ATD | A TIME/DIV | 0 : EXT CLOCK<br>1 : 10 s<br>2 : 5 s<br>3 : 2 s<br>4 : 1 s<br>5 : 0.5 s<br>6 : 0.2 s<br>7 : 0.1 s<br>8 : 50 ms<br>9 : 20 ms<br>10 : 10 ms<br>11 : 5 ms<br>12 : 2 ms<br>13 : 1 ms<br>14 : 0.5 ms<br>15 : 0.2 ms<br>16 : 0.1 ms<br>17 : 50 µs<br>18 : 20 µs<br>19 : 10 µs<br>20 : 5 µs<br>21 : 2 µs<br>22 : 1 µs<br>23 : 0.5 µs<br>24 : 0.2 µs<br>25 : 0.1 µs<br>26 : 50 ns<br>27 : 20 ns |
| (19) BTD | B TIME/DIV | 7 : 0.1 s<br>8 : 50 ms<br>9 : 20 ms<br>10 : 10 ms<br>11 : 5 ms<br>12 : 2 ms<br>13 : 1 ms<br>14 : 0.5 ms<br>15 : 0.2 ms<br>16 : 0.1 ms<br>17 : 50 µs<br>18 : 20 µs<br>19 : 10 µs<br>20 : 5 µs<br>21 : 2 µs<br>22 : 1 µs<br>23 : 0.5 µs<br>24 : 0.2 µs<br>25 : 0.1 µs<br>26 : 50 ns<br>27 : 20 ns |
| (20) AVA | A VARIABLE | $0 \leqq \sim \leqq 257$ |
| (21) HLD | HOLDOFF | $0 \leqq \sim \leqq 200$ |
| (22) TRS | TRACE SEPARATION | $0 \leqq \sim \leqq 255$ |

| | | | | |
|---|---|---|---|---|
| | | CH 2 → REF 2<br>4 : CH 1 → REF 2<br>5 : CH 2 → REF 1<br>6 : CH 1 → REF 2<br>CH 2 → REF 1 | | |
| (34) IPL | CURVE INTERPOLATION | 0 : OFF<br>1 : ON | | |
| (35) CAL | CALCULATION +, –, X | 0 : OFF<br>1 : ON | 1 : +<br>2 : –<br>3 : X | |

| Commands | Contents | Parameter (1) | Parameter (2, 3) | Parameter (4, 5) |
|---|---|---|---|---|
| (36) a. YNC | GO/NO Cur. to Cur. | 0 : OFF<br>1 : IN-RANGE<br>2 : OUT-RANGE | $-512 \leqq \sim \leqq +511$ | $0 \leqq \sim \leqq +2047$ |

| Commands | Contents | Parameter (1) | Parameter (2, 3) | Parameter (4) |
|---|---|---|---|---|
| b. YNW | GO/NO Cur. to Wave | 0 : OFF<br>1 : IN-RANGE<br>2 : OUT-RANGE | $0 \leqq \sim \leqq 2047$ | 1 : WFM MEM 1<br>2 : WFM MEM 2<br>3 : WFM MEM 3<br>4 : WFM MEM 4 |
| | | Parameter (5) | Parameter (6) | Parameter (7) |
| | | $-256 \leqq \sim \leqq +255$ | 1 : WFM MEM 1<br>2 : WFM MEM 2<br>3 : WFM MEM 3<br>4 : WFM MEM 4 | $-256 \leqq \sim \leqq +255$ |

| Commands | Contents | Parameter (1) |
|---|---|---|
| (37) AVR | AVERAGING | 0 : OFF<br>1 : 2<br>2 : 4<br>3 : 8<br>4 : 16<br>5 : 32<br>6 : 64<br>7 : 128<br>8 : 256 |
| (38) EQS | EQUIVALENT SAMPLING | 0 : OFF<br>1 : ON |
| (39) LCL | LOCAL | No parameter |
| (40) LLO | LOCAL LOCK OUT | 0: OFF<br>1: ON |

MP MASTER
MA31028